PUBLIC HEALTH REPORTS

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Public Health Service

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Volume 70, Number 10

OCTOBER 1955

Published since 1878

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frontispiece

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PUBLIC HEALTH REPORTS

Public Health Reports, published since 1878 under authority of an act of Congress of April 29 of that year, is issued monthly by the Public Health Service pursuant to the following authority of law: United States Code, title 42, sections 241, 245, 247; title 44, section 220. The printing of this publication has been approved by the Director of the Bureau of the Budget, September 17, 1954.

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
MARION B. FOLSOM, *Secretary*

PUBLIC HEALTH SERVICE
LEONARD A. SCHEELE, *Surgeon General*

> *"History is simply the biography of the mind of man; and our interest in history, and its educational value to us, is directly proportionate to the completeness of our study of the individuals through whom this mind has been manifested."*
>
> —OSLER

Contributions by Medical Undergraduates to the Science of Preventive Medicine

By WILLIAM C. GIBSON, M.D., D.Phil.

THE AVERAGE student today is likely to greet with a mixture of amusement and pity any suggestion by his teachers that he might make a lasting contribution to medical science. Students have wallowed through mountainous academic seas for so long in convoy fashion—the speed of the fleet being set by the speed of the slowest ship—that their imagination has been blunted, if not embalmed. It is in the hope of resurrecting some of the keenness of students' first bright days in medical school that the following essay on student contributors of the past is presented. The inquiring, restless mind of the uninhibited undergraduate is still our greatest asset in medicine and the greatest deterrent to smugness in research.

Educators and administrators also would do well to review in retrospect the lives of past contributors in the field of preventive medicine, for in such a study there may be found the key to further recruiting and development of exceptional personnel. I mention educators because the critical ingredient—gray matter—passes through their hands. Their attitude, as we shall see throughout this paper, can be absolutely determinative. They can foster discovery, or they can impede it. I mention administrators, for they face a dilemma—they have to make existing methods work while insuring that they are not brushing aside as a "nonconformist" some potential discoverer.

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Smallpox

Appropriately, this review is opened with a reference to Edward Jenner, who combined early vision, fortitude in the face of powerful critics, and a life-long delight in clinical investigation. Jenner found himself, in 1768 at the age of 19, a quaking medical apprentice noting down a patient's history, possibly one of his first. The patient was a milkmaid who, on being questioned about any possible smallpox in her history, replied, "I cannot take that disease for I have had the cowpox." Thus, the fledgling Jenner encountered early in his career the common belief among the country people of Gloucestershire that there was a harmless preventive of smallpox. Perhaps his newness to the study of medicine caused him to listen

long enough to this patient's replies to gain something of value. His countryman William Withering was to stumble on the virtues of digitalis in a similar rural setting in Shropshire.

Jenner became, as have many since, a student unpopular with his teachers, for he kept bringing up his fantastic theory, as from the back pasture. However, he lived in John Hunter's house while studying in London, and his patron greatly encouraged the thoughtful undergraduate. Hunter's philosophy was couched in his immortal advice to Jenner, "But why think, why not try the experiment."

Jenner graduated at the age of 22, and, despite an offer to accompany Captain Cook on a world-circling expedition, he returned to his native Gloucester to practice and to build up a set of records on simple, clear observations. So cautious was Jenner that he vaccinated no one for 30 years after his undergraduate conception of vaccination. Then came Sarah Nelmes—the source—and James Phipps—the subject. And Jenner's campaign, for he was a campaigner, was launched.

John Hunter had been dead 5 years by the time Jenner was ready to publish the results of his inquiry. Jenner turned to the Royal Society in 1798 for an audience and was rebuffed with the advice that he "should be cautious and prudent . . . and ought not to risk his reputation by presenting to the learned body anything which appeared so much at variance with established knowledge, and withal so incredible."

The same advice had been given Franklin by the same body in 1752 when he reported on his derivation of electricity from the clouds. The type of advice offered Jenner, who happens to have been a keen balloonist, was 140 years later to be tendered another aeronaut Frank Whittle, the jet propulsion pioneer, on the grounds that he was still a Cambridge undergraduate and his theory was "incredible."

Tuberculosis

In another area—that of tuberculosis—one is struck by the student contributions of the impecunious, observant, and industrious René Theophile Hyacinthe Laennec. Before graduation in Paris in June 1804, he had written papers on mitral valvular disease and on "inflammation of the peritoneum" under the stern and powerful Dupuytren. He had discovered the subdeltoid bursa and had also shown that hydatid cysts were due to parasites. In March of 1804, he gave an address on what he called "pulmonary tuberculosis," in which he showed "phthisis" to be tuberculosis of the lungs.

Laennec learned of percussion from Jean-Nicolas Corvisart, who brought this clinical application of an innkeeper's barrel-tapping technique into use 47 years after Leopold Auenbrugger had first described it. Laennec's great book on auscultation appeared in 1819, and by 1825 we find William Stokes, as an Edinburgh medical undergraduate, singing the praises of the method in his book, the first work in English on auscultation, entitled "An Introduction to the Use of the Stethoscope with its Application to the Diagnosis in Disease of the Thoracic Viscera; Including the Pathology of Various Affections."

An unsung American contributor in the history of tuberculosis is James Jackson, Jr., of whom Osler wrote: "Jackson's name . . . will always be associated with the studies on emphysema, and he is the discoverer of the prolonged expiration in pulmonary tuberculosis." As an undergraduate Jackson studied with the great French clinician and pathologist Louis. In 1832 he sent home to New England an article on cholera based upon his experience with Louis in an epidemic in France. While preparing to write his M.D. examinations at Harvard, he was stricken with dysentery and died at the age of 24. Louis' letters to Jackson's father asking if the son could not spend another year in his clinic in Paris are very touching.

Another American pioneer in tuberculosis was James Blake (1815–93). In 1860 he was recommending and practicing the open-air rest treatment in a sanatorium on the summit of Monte Sol in California to the east of Mount St. Helena where Robert Louis Stevenson later lived. Blake's student contribution had been the arranging of the elements into a periodic table on the basis of their physiological effects. This was done when Blake was an undergraduate in London, aged 23. Mendelejeff, usually credited with the periodic table, was 4 years old at the time of Blake's publication. Blake's student discovery was made under the benev-

olent eye of William Sharpey, as were those by Lister and Huxley.

Puerperal Fever

Ignaz Philipp Semmelweis and Oliver Wendell Holmes had interesting student preparations for their eventual encounter with puerperal fever. As an undergraduate Semmelweis was experimenting on rabbits with tartar emetic, at that time a preferred "remedy" for

". . . not to take authority when I can have facts, not to guess when I can know . . ."—Holmes.

pneumonia. Holmes, like Semmelweis, had spent a brief apprenticeship in law—a discipline which was to serve them, and humanity, well in the struggle to which their methodical investigation brought them. Holmes began the study of medicine under James Jackson, Sr., in Boston and continued it in Paris, along with Jackson's son already mentioned. In a letter sent to his home in Boston, he alluded to his student "discoveries": "I have more fully learned at least three principles since I have been in Paris: not to take authority when I can have facts; not to guess when I can know; not to think a man must take physic because he is sick. . . . My aim has been to qualify myself . . . not for a mere scholar, for a follower after other men's opinions, for a dependent on their authority—but for the character of a man who has seen and therefore knows, who has thought and therefore has arrived at his own conclusions." Holmes, the Bostonian, a nationally known poet at 21, little suspected that a fiercely independent Hungarian practicing in Vienna unknowingly would be his ally. Holmes' pen was mightier than the swords of his obstetrical compatriots. Semmelweis maintained his doctrine against frightful persecution because he knew he was right and he had the support of his teachers Rokitansky, Skoda, and Hebra.

Cellular Pathology

One of the great concepts introduced in the last century was that of "cellular pathology." Rudolf Virchow as an undergraduate in Berlin decided to test the prevailing theory that inflammation was vascular in origin by studying it in the cornea, a nonvascular tissue. His graduation thesis, written in 1843, was entitled, "De rheumate praesertim corneae." We believe from a letter of 1841 written to his father in the country, asking for more rabbits, that he had been engaged on it at least 2 years prior to graduation. Virchow's student work on the cornea determined his later opinions on the cellular basis of inflammation and doubtlessly influenced his outlook on the fundamentals of pathology.

The distinguished physician-educators Sir James Paget and Sir William Osler were student investigators, strangely enough, in the same field. As an undergraduate at St. Bartholomew's Hospital Medical School, London, Paget in 1835 discovered the cysts of *Trichinella spiralis* in the muscles of the cadaver he was dissecting. In 1870, William Osler, a first-year medical student at the University of Toronto, was removing these trichinae from a cadaver and trying to infect cats, dogs, and rabbits with them. Osler entered medicine with training in the preparation of biological specimens, received at the skilled hands of James Bovell and Father Johnson at their school in Weston, Ontario. On graduation at McGill Medical

Faculty in 1872 his thesis was accompanied by such excellent histological preparations that he was awarded a special prize. Osler's early bent toward pathology was evident throughout his long clinical career. It remained for an undergraduate at Johns Hopkins Medical School, Thomas R. Brown, to discover in 1898 the eosinophilia seen in trichinosis.

David Gruby, the father of medical mycology and discoverer of the cause of favus, was in 1835 an undergraduate protégé of Carl Rokitansky, the celebrated teacher and pathologist at the University of Vienna. Gruby wrote his first paper on "The Morphology of Pathological Fluids." His study concerned the cell forms in pus from different diseases. The story of the hardships faced and overcome by this remarkable spirit are well-nigh unbelievable. He acquired his early schooling by listening outside a classroom from which he was barred on religious grounds. He was apprenticed to a lens grinder, and as a result he was able to make his own microscope when he entered medical school. Despite the fact that he earned his passage through medicine by tutoring, he nevertheless found time for research under Berres and Rokitansky, the latter permitting him to use his "best microscope" for it. Once again does Rokitansky, the teacher of pathology, enter upon our stage.

Oroya Fever

Daniel Carrion is probably the only medical student in history to have a medical school and several hospitals named after him. Separated as we are by a period of 70 years from his death from Oroya fever, administered to him in the course of his student research project, it is hard for us to realize the impression which his death made on Latin American medical and scientific circles. As early as 1858, a medical student named Tomas Salazar wrote in his graduation thesis, "Historia de las Verrugas," that this disease was waterborne. Since the Conquest it had been regarded as the equal of the "pest," and in the year 1870 alone had taken the lives of 7,000 workmen completing the trans-Andean railroad into Oroya, Peru. Carrion became interested in the problem and during vacations sought out cases and plotted them on a map of the area. Only near Oroya was the disease endemic. The clinical picture of high fever, profound weakness, joint pains, anemia, and leukocytosis was well known, but the cause was still a mystery. Some called it acute pernicious anemia, some atypical malaria, while others said it originated from the hot springs. On August 27, 1885, Carrion, against all advice, received an inoculation of blood from a 14-year-old boy suffering from the typical verruga peruana skin eruption. He was going to prove, once for all, the connection between Oroya fever and verruga peruana. After 3 weeks of excellent health he suffered muscular pains and prostration, with severe anemia. The post mortem was an important contribution to an understanding of the disease. The Peruvian student had answered the question of the connection between the two diseases.

Patrick Playfair Laidlaw as a Cambridge undergraduate, at the turn of the century, carried on an important investigation on hemoglobin derivatives in the biochemical laboratory of Sir Frederick Gowland Hopkins. This set the stage for his postgraduate work on histamine with Sir Henry Dale and for his lifelong researches into distemper and influenza. Hopkins must be listed among those who most encouraged young investigators.

William George MacCallum entered Johns Hopkins Medical School in 1894 bearing a gold medal from the University of Toronto for an important contribution on worm parasites. In his final year as a student at Johns Hopkins he reported on his studies of malarial parasites in birds. He supplied the missing link in the life cycle of the parasite, showing the flagellated form to be the sperm cell. Sir Ronald Ross, who had interpreted it as a flagellated spore escaping from a female cell, wrote years later: "I have ever since felt disgraced as a man of science!" MacCallum's later discovery of the role of the islet cells of the pancreas in diabetes became the springboard for Banting's revolutionary work, aided by the youthful Charles Best. In fact, as we shall see, the islet cells had been discovered by a medical student, Paul Langerhans.

An Inquiry into the natural History of a Disease known in Glostershire by the name of the Cow-pox

The deviations of Man from the state in which he was originally placed by Nature seem to have proved to him a prolific source of Diseases. From the love of splendor, from the indulgences of Luxury, & from his fondness for amusement, he has familiariz'd himself with a great number of animals which may not originally have been intended for his associates. The Wolf, disarm'd of its ferocity, is now pillow'd in the Lady's lap*. The Cat, the little Tyger of

* The late Mr John Hunter proved by experiments that the Dog is the Wolf in a degenerated state.

Reproduced above is the first page of William Jenner's classic which he presented to the Royal Society in 1798—three decades after he had noted the comment of a Gloucestershire milkmaid that she once had cowpox and therefore could not get smallpox. The Royal Society reprimanded him for this "incredible" paper, "so much at variance with established knowledge."

Chemotherapy

The father of modern chemotherapy, Paul Ehrlich, stated his great side-chain theory as a medical student. Encouraged by one of his teachers, Waldeyer, at Strassburg, Ehrlich began in 1877, by testing the staining qualities of many of the aniline dyes just coming into commercial use in Germany. After transferring to the University of Breslau he had the opportunity of working in the laboratories of Conheim and Heidenhain. While still an undergraduate Ehrlich described, in the *Archives of Microscopic Anatomy*, his experiments on histological staining which brought him to the "idea of a chemical binding of heterogeneous substances to the protoplasm." The rest of Ehrlich's life was spent in developing this great generalization in the fields of immunity, bacteriology, and chemotherapy. The key to Ehrlich's research lay in the aniline dyes, the first of which was synthesized by an 18-year-old English chemistry student William Henry Perkin. Two years later Archibald Scott Couper, as a student in Paris, proposed a valency of four for carbon and showed that it formed long-chain compounds. It took the genius of Ehrlich, a chemist with great stereovisual powers and interest in tissues, to bring together into a fundamental concept all that had gone before.

Public Health

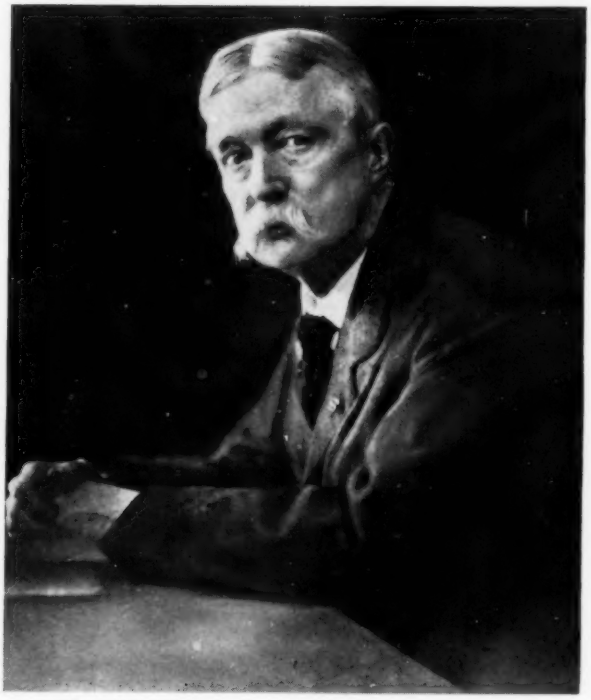
John Shaw Billings has been described as America's greatest contributor to scientific medicine. He was a born inquirer rather than the product of famous teachers. As a student, writing an essay on the surgical treatment of epilepsy, he came to realize the utter lack of any index to the world's medical literature. He lived to remedy this, through the Index Catalogue and its successors in the library of the Surgeon General of the United States Army.

However, our interest in Billings here stems from his campaigns in the fields of sanitation and hospitalization. As an impoverished student at the Medical College of Ohio in Cincinnati from 1858 to 1860, Billings paid his way by serving as caretaker of the dissecting rooms and by "living in" at one of the city's hospitals. This latter appointment caused him to think more about the organization of hospitals—or possibly lack of it—than did contemporary administrators. He found out where things could "go wrong" in institutions and he developed a keen sense of smell with regard to these matters.

It is little wonder that on his first Army posting in the Civil War Billings excoriated Cliffburne General Hospital in Washington, D. C., as being "in an extremely filthy and dilapidated condition—no drainage whatever, . . . no sinks, no water within half a mile." He was later to describe the United States Army as "the best fed and the worst housed" in the world. His suggestions for reorganizing the marine hospitals and his sanitation reports on Army military posts were blunt and forceful. One of his interests was vital statistics, and in 1880 he suggested to the Government that the data compiled from the census "might be recorded on a single card or slip by punching small holes in it, and that these cards might then be sorted and counted by mechanical means according to any selected group of these perforations."

Billings' stimulating influence was to be felt in his work as director of the laboratory of hygiene at the University of Pennsylvania, as designer of the Johns Hopkins and Peter Bent Brigham Hospitals, and in medical education and libraries. When asked how he accomplished so much he replied: "There is nothing really difficult if you only begin. Some people contemplate a task until it looms so big it seems impossible. But I just begin and it gets done somehow. There would be no coral islands if the first bug sat down and began to wonder how the job was to be done."

Thomas "Phenomenon" Young, that many-sided genius who discovered in his first days at medical school that the lens of the eye varies its shape in accommodation was an early constructor of life expectancy tables and of insurance formulas. His first was published in 1826 as "A Formula for Expressing Decrement of Human Life." In his theory of color vision—rediscovered years later by Helmholtz—in his accurate measurements of the size of red and white cells of the blood, in the deciphering of the Rosetta stone, in developing the modulus of elasticity, in setting out a phonetic alphabet for all languages, in standardizing the imperial gallon, and in his writings on gaslighting,



"There is nothing really difficult if you only begin. . . . There would be no coral islands if the first bug sat down and began to wonder how the job was to be done."—Billings.

Young made himself one of the most celebrated scientific contributors of all time. If he were alive today we would find him, doubtless, energizing the Food and Agriculture Organization with reports of his observations on the production of better wool and meat through crossbreeding and of increased food production through irrigation, matters which he studied as a medical student. His drive to understand things was inexhaustible and his capabilities truly Newtonian.

Nutrition

The field of nutrition reveres the name of Sir Frederick Gowland Hopkins for his early researches on "accessory food factors" which we now call vitamins. Before graduation in medicine, Hopkins published a paper on the pigments in the wings of the English brimstone butterfly. He found the pigment to be a derivative of uric acid and, in his typical way, immediately improved the method for the determination of uric acid. This method was the key to his succeeding researches on nitrogenous compounds. As he investigated the effects of artificial diets composed of purified proteins he became aware of "unidentified accessory food factors" and pursued them, with what great success we all know today.

To follow briefly this lead in nutrition one finds the field of carbohydrate metabolism bristling with student contributors. But, it is the disease diabetes which absorbs us as physicians interested in public health problems. Paul Langerhans discovered his famous "islets" in the pancreas 2 years before he graduated in medicine. Virchow had given him encouragement and laboratory space in 1867, and his graduation thesis, completed in 1869, is an historic document. In 31 pages he described his discovery, adding: "There is indeed hardly another organ in which there is such glaring contrast between the brilliant results of physiological research and the complete darkness in the realm of anatomic knowledge."

The deposition of calcium in the teeth and bones of the body was poorly understood until the Swedish medical student, Ivar Sandstrom, in 1877 discovered the parathyroid glands. True, it remained for W. G. MacCallum and others to demonstrate the physiological principles involved, but Sandstrom's investigation as a 25-year-old student at Uppsala was basic to further progress. His paper was returned to him by a German editor as being too long to publish. The fact is that the paper was so thorough that little has been added to the subject since!

At a time when cardiovascular disease is receiving such attention we would do well to review the student work of Jean L. M. Poiseuille. In 1828 he wrote his M. D. thesis in Paris on "Recherches sur la force du coeur aortique" and in it described his revolutionary mercury manometer for registering blood pressure. Using this instrument he was able to show the rise and fall in the recorded blood pressure with each heart beat, and he actually calculated the degree of dilation of the arteries with each systole.

Aviation medicine has had a number of interesting undergraduate devotees. Alphonse Gal, while a medical student in Italy, served in 1872 on a "mother ship" for sponge divers operating off the Turkish coast. He was the first

to describe the itching which goes with "the bends" in deep sea divers. The father of aerial photography, Felix Tournachon, was a medical student. Known as "Nadar," he, like Jenner, was one of the early balloonists. With this reference to the latest specialty we must conclude this account.

Certainly, one thing is clear from this brief review of 2 dozen student contributors of the past: Good seed can be helped greatly by good soil. The determining factor has often been the provision of facilities for a student investigator by a sympathetic teacher. The lesson for us today would seem to be clear. Summer research scholarships in all fields of medicine and its ancillary sciences are likely to repay us handsomely as educators. Encouragement of original work by undergraduates is in the best tradition, as I have tried to show in this paper, and offers one method of offsetting the homogenizing influence of too many specialty boards. Student curiosity can be depended upon to bring to light new facts of major importance, as it has in the past. The shaping of the conditions under which such students will work and grow is a major challenge to all educated people.

Medical Research Fellowships

The Division of Medical Sciences is accepting applications for National Academy of Sciences-National Research Council postdoctoral research fellowships for 1956–57. The following programs, offered only—except as indicated—to American citizens under 35, are available:

Study in all branches of the biological, chemical, and physical sciences, and of clinical investigation applicable to the study of typical or malignant growth; also, exchange fellowships open to American and British scientists for advanced study in specialized fields pertaining to growth. These awards are sponsored by the American Cancer Society.

Fellowships in the basic medical sciences. These awards, also open to Canadian citizens, are supported by the Rockefeller Foundation.

Study in fields related to tuberculosis, supported by the National Tuberculosis Association. Applicants must be graduates of American schools.

Preparation for radiological research. Appointments to this program, sponsored by the James Picker Foundation, are not limited to citizens of the United States.

The closing date for applications is December 1, 1955. Forms may be obtained from the Fellowship Office, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, NW., Washington 25, D. C.

Data on vital events, communicable diseases, and sanitation reported by 22 American countries signify progress in neighbor nations.

Report of Health Conditions in the Americas

By GUSTAVO MOLINA, M.D., M.P.H., and RUTH R. PUFFER, Dr.P.H.

NEED for a numerical statement of facts, with precision and reliability, has been a matter of prime concern to persons interested in coordinated health planning in the Americas. Since establishment of the Pan American Sanitary Bureau in 1902, improvement in collection of statistical data has been one of the important objectives of the organization. Although achievement of this objective has been given impetus by the many requirements of the Pan American Sanitary Code in relation to statistics and reports, only in recent years has it received concentrated effort.

A major goal in fulfillment of the requirements in the Pan American Sanitary Code was the publication of the Summary of Reports of Member States, 1950–53, which was prepared for the XIV Pan American Sanitary Conference held in October 1954. This document consolidates the statistical data on health conditions for the years 1950 through 1953 that were submitted by each of the 21 member states of the Pan American Sanitary Organization. Included are data on population, vital events, reported cases and control of communicable diseases, personnel and organization of health services, and various aspects of sanitation programs. Since release of the summary, similar reports have been received from Puerto Rico, Canada, and the territories in the Western Hemisphere, which will be incorporated in a revision of the summary. For the following discussion, selected data dealing with population, vital events, communicable diseases, and sanitation from the reports of the member states and Canada are presented. These data provide a basis for appraisal of general health conditions in the Americas.

Dr. Molina is chief of the division of public health of the Pan American Sanitary Bureau, and Dr. Puffer is chief of the division's epidemiology and statistics section. *Assistance in presenting the vital statistics data in this paper was provided by Jean Peabody, a member of the staff of the epidemiology and statistics section. The paper was read at the 23d annual meeting of the Southern Branch of the American Public Health Association in New Orleans, May 10–13, 1955. It is scheduled to be printed in Spanish in the October 1955 issue of the Boletín de la Oficina Sanitaria Pan-Americana.*

Population

Nearly all the countries in the Americas conducted a census in or about 1950, and on July 1 of that year the population was estimated to be 326,415,000. Of this population, 216,443,000

Table 1. Percentage of population in 4 age groups for 3 regions of the Americas according to recent census in 18 countries

Region	All stated ages	Under 15 years	15–34 years	35–54 years	55 years or more
Northern America	100.0	27.2	30.5	25.5	16.8
Middle America	100.0	41.8	32.8	17.9	7.5
South America	100.0	40.0	34.3	18.4	7.3

lived in North America and 109,972,000 in South America. In Alaska, Canada, Greenland, St. Pierre and Miquelon, and the United States, which is called Northern America, were 165,110,000 people, and in the remainder of North America (including the islands of the Caribbean), which is designated Middle America, were 51,333,000.

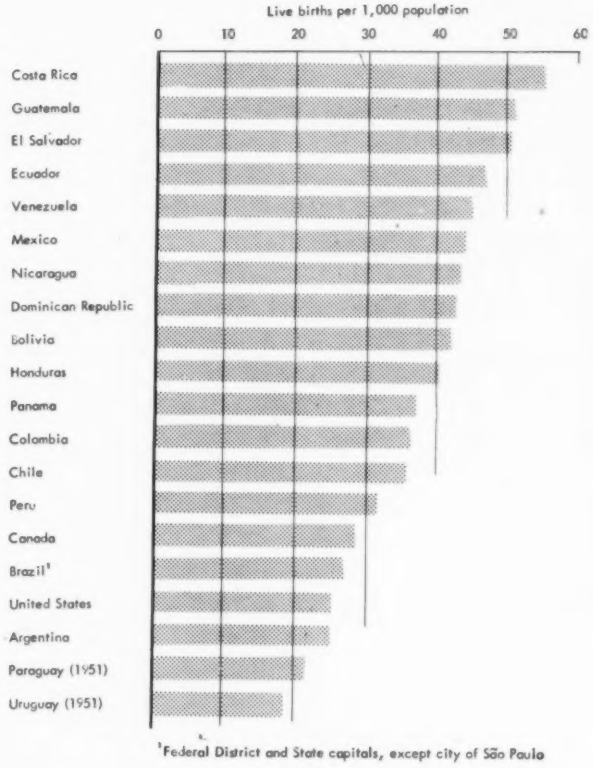
Division of the population into age groups, as presented in table 1, demonstrates a sharp difference between Middle and South America and Northern America. In Middle and South America the proportion of the population under 15 years of age is substantially higher than the proportion in Northern America, 42 percent and 40 percent as compared to 27 percent. The proportion in the older age groups is considerably lower in Middle and South America, although the proportion in the age group 15–34 years is about the same in all three regions. These age distributions indicate that in Middle and South America greater priority at present should be given to health programs directed to problems of infancy, childhood, and young adult life.

Table 2. Birth and death rates per 1,000 population and infant death rates per 1,000 live births in 20 American countries, 1952

Country	Birth rate	Death rate	Infant death rate
Argentina	24.6	8.7	67.5
Bolivia	42.1	15.6	184.6
Brazil [1]	27.1	15.7	172.9
Canada [2]	27.9	8.7	38.0
Chile [3]	36.5	13.7	121.8
Colombia	36.8	13.0	110.7
Costa Rica	54.6	11.6	80.2
Dominican Republic	42.2	10.1	78.7
Ecuador	46.5	17.0	[4] 109.5
El Salvador	50.8	17.0	85.5
Guatemala	51.0	24.2	112.2
Honduras	40.1	12.7	64.3
Mexico	43.3	14.8	89.7
Nicaragua	42.8	10.6	77.5
Panama	36.9	8.6	50.4
Paraguay [4 5]	20.8	7.0	87.7
Peru	31.4	11.2	100.0
United States	24.7	9.6	28.4
Uruguay [4]	18.6	7.9	54.7
Venezuela	44.0	10.8	74.7

[1] Federal District and State capitals, except the city of São Paulo. [2] Excluding Yukon and Northwest Territories. [3] Provisional. [4] 1951. [5] For reporting area, 83 percent of population.

Figure 1. Live births per 1,000 population in 20 American countries, 1952.



[1] Federal District and State capitals, except city of São Paulo

Vital Statistics

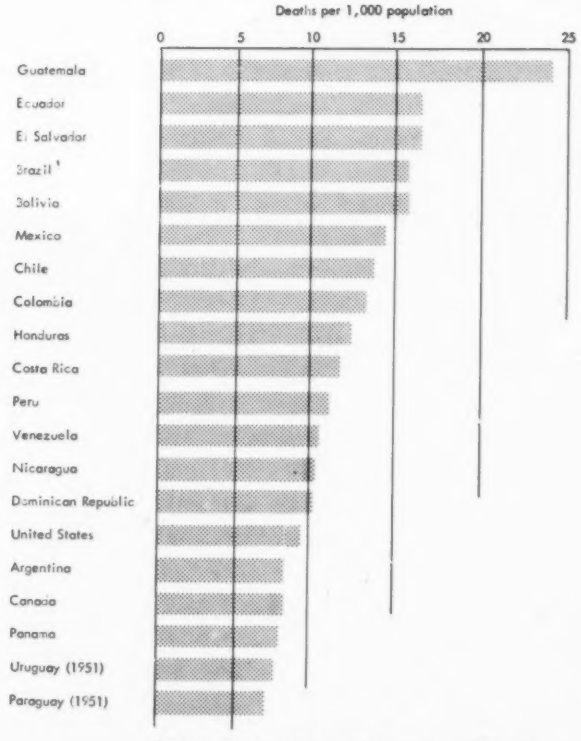
Practices in registering vital events, definitions of terms, and tabulation procedures vary considerably from country to country. Although the reports on health conditions were not concerned with the technical details of the methods of collecting and analyzing data, certain explanations should be made.

The data provided by Haiti were considered too incomplete to be used because this country does not have a vital events registration system. Cuba did not provide any birth or death data. In Brazil, data were available only for the Federal District and capitals of States, except the city of São Paulo. In some of the countries, notably Paraguay, the low rates indicate incomplete registration of births and deaths.

The birth, death, and infant death rates reported by 20 countries for 1952 are given in table 2, and these rates are shown by rank order in figures 1, 2, and 3. Notwithstanding the difficulties involved in providing complete information for the hemisphere, the statistics presently available from birth and death certificates do give valuable clues to the health problems in the various countries. The need for improving vital statistics systems becomes increasingly evident as the data are used.

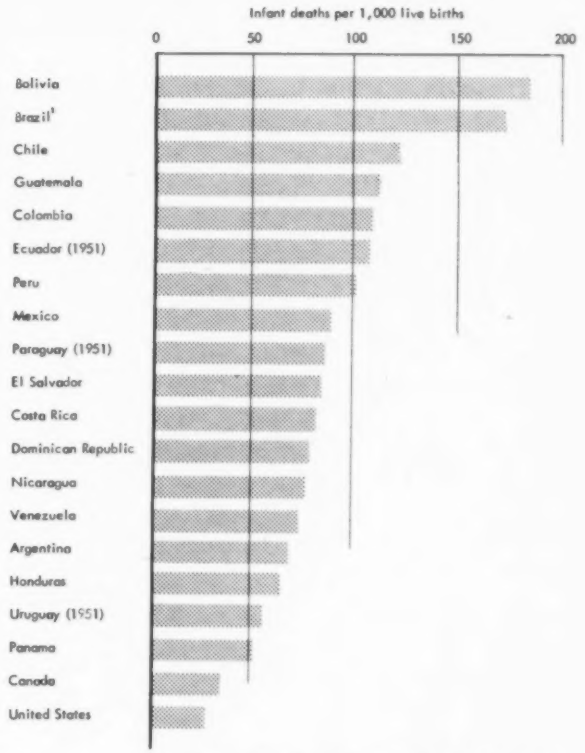
Very high birth rates were noted in many of the countries. In fact, in half of them the the rates exceeded 40 per 1,000 population and in 3 countries of Central America they were

Figure 2. Deaths per 1,000 population in 20 American countries, 1952.



[1]Federal District and State capitals, except city of São Paulo

Figure 3. Infant deaths per 1,000 live births in 20 American countries, 1952.



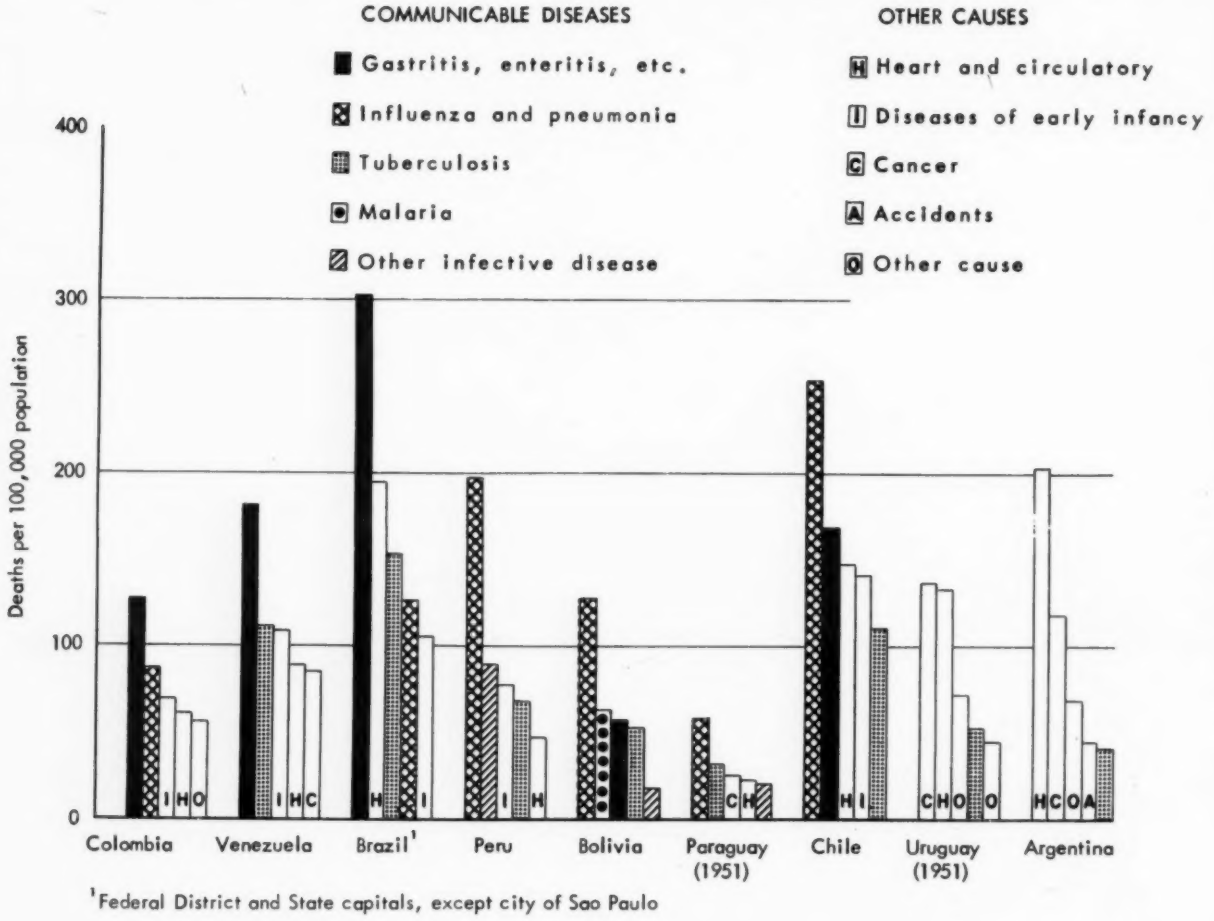
[1]Federal District and State capitals, except city of São Paulo

in excess of 50 per 1,000 population. Such high birth rates indicate that maternal and child health programs are essential for proper care in the prenatal and postnatal periods and in childhood.

Likewise, high death rates were found in several of the American countries, the highest being recorded in Guatemala. Although death registration is incomplete in several countries and the true rates are probably higher, the data indicate excessive mortality in many areas. However, analysis of death rates from specific causes as well as by age group is clearly required for understanding of health conditions.

The range in infant death rates was great, from 28.4 per 1,000 live births in the United States to 184.6 per 1,000 live births in Bolivia. The fact that the United States and Canada have been able to bring their infant death rates down to relatively low figures gives promise that, with the development of health programs, improvement of environmental sanitation, and prevention of infectious diseases, rates can like-

Figure 4. The 5 leading causes of death in 9 countries of South America, 1952.



[1]Federal District and State capitals, except city of Sao Paulo

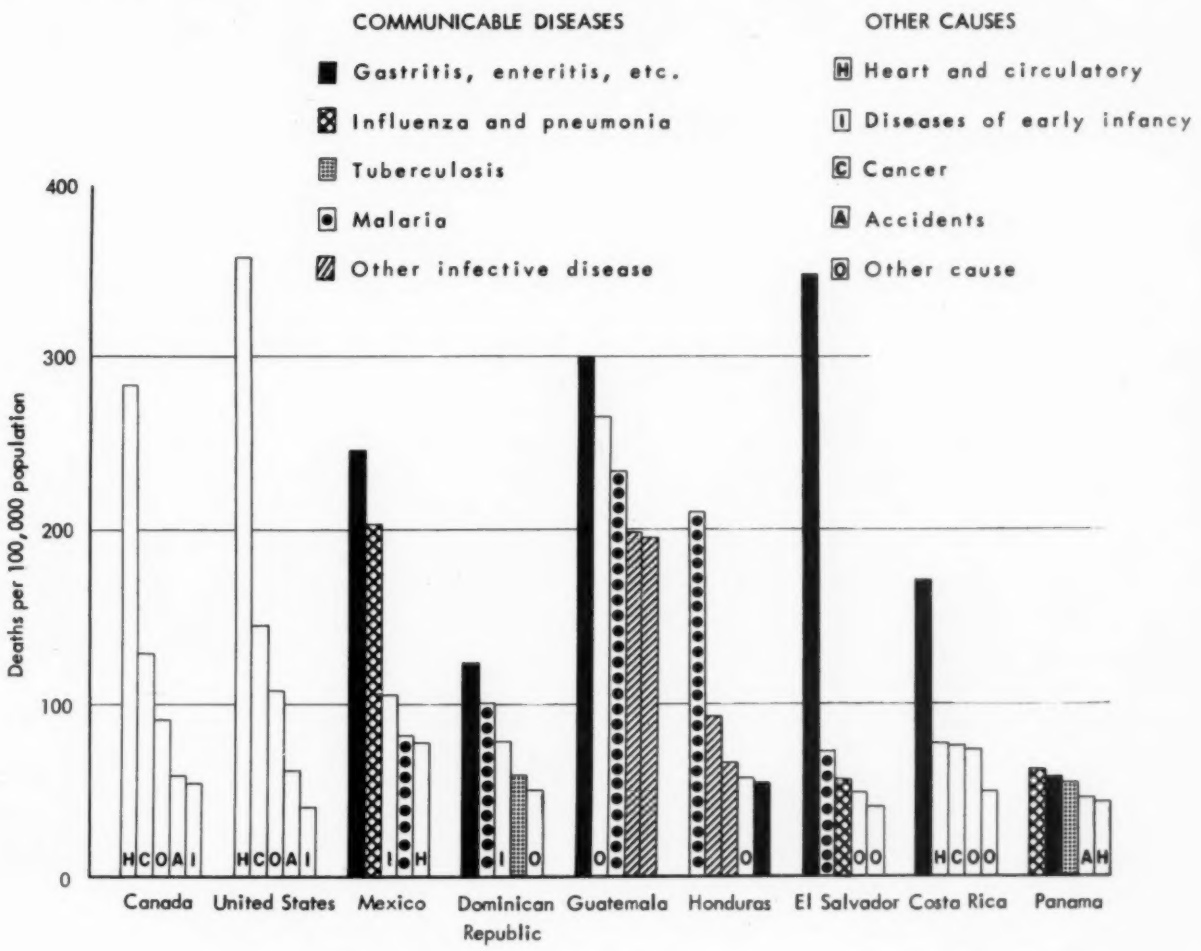
wise be reduced throughout the hemisphere. Forty years ago, at the time of establishment of the Birth Registration Area in the United States, the rate for the 10 States and the District of Columbia, although probably lower than for the rest of the country, was still around 100 per 1,000 live births. Reduction was steady but not even, with some States maintaining relatively high rates until very recent years. Similar unevenness can be expected in the declines in other countries. In those countries which have put into force vigorous public health programs, clear-cut reductions have been noted, and it is to be hoped that the downward trend will continue.

Principal Causes of Death

Eighteen countries provided data regarding the principal causes of death. In considering these data, it must be kept in mind that not all countries used the International Statistical Classification of Diseases, Injuries, and Causes of Death (sixth revision of the International List) and that there was not uniformity in the title numbers used in ranking the causes of death. Moreover, it is known that there are deficiencies in registration and medical certification in certain countries, such as Bolivia, Paraguay, and Peru.

The 5 leading causes of death in 9 countries of South America are shown in figure 4. In the three northernmost countries—Colombia, Venezuela, and Brazil—the gastrointestinal diseases, that is, the diarrheas, which are probably due principally to shigella, were the leading cause of death. In four countries farther from the tropics—Peru, Bolivia, Paraguay, and Chile—influenza and pneumonia were the principal cause of death. In Uruguay and Argen-

Figure 5. The 5 leading causes of death in 9 countries of North America, 1952.



tina, the diseases in the older age groups, circulatory diseases and cancer, stood first.

Figure 5 gives similar data for 9 countries in North America. In Canada and the United States, the infective diseases did not appear among the 5 leading causes. In the other 7 countries, the infective diseases—the diarrheal diseases, malaria, and influenza and pneumonia—appeared frequently.

A summary of the data on principal causes of death is given in table 3. These data point up the importance of the infective and parasitic diseases, for in addition to the diarrheal diseases, which were the principal cause of death in 8 countries and among the first 5 causes in 12 countries, influenza and pneumonia, tuberculosis, malaria, and whooping cough appeared as leading causes. Even though there is lack of uniformity in classifying and ranking deaths and variations in completeness of reporting and accuracy of medical certification, the data emphasize the need for active programs for prevention of death due to communicable diseases.

Communicable Diseases

As has been pointed out, the communicable diseases rank high among the first five causes of death in many countries of the Americas. They contribute heavily to infant mortality and mortality in early childhood. In addition to mortality, furthermore, these diseases are responsible for considerable illness and economic loss. The reports on health conditions provided detailed data regarding 15 communicable diseases, including the number of cases and deaths with rates per 100,000 population. In table 4 are shown the death rates for two of these diseases, malaria and whooping cough.

Table 3. Summary of the 5 principal causes of death by rank order in 18 American countries, 1952

Cause of death	Total	Number of countries by rank order of cause of death				
		1st	2d	3d	4th	5th
Heart disease or circulatory system	13	3	3	1	3	3
Gastritis, enteritis, diarrhea [1]	12	8	2	1	0	1
Influenza and pneumonia [2]	10	5	2	2	1	0
Tuberculosis	10	0	2	2	4	2
Diseases of early infancy	9	0	0	5	1	3
Cancer	7	1	3	2	0	1
Bronchitis [3]	6	0	1	0	1	4
Malaria	6	1	3	1	1	0
Vascular lesions, etc.[4]	5	0	0	4	0	1
Accidents or external causes	4	0	0	0	4	0
Whooping cough	2	0	1	0	1	0
Other cause	6	0	[5] 1	0	[6] 2	[7] 3

[1] Diseases of digestive system in two countries. [2] Diseases of respiratory system in one country. [3] Includes bronchopneumonia in one country and pneumonia in two countries. [4] Diseases of nervous system in one country. [5] Intestinal infections. [6] Avitaminosis and anemias in one country and dropsy in one country. [7] Dysentery, helminths, and syphilis, each in one country.

Malaria is one of the communicable diseases that results in considerable morbidity and mortality in certain areas of the hemisphere. The six countries with the highest death rates are in North America—Guatemala, Honduras, Dominican Republic, Nicaragua, Mexico, and El Salvador. As is well known, malaria has also been a serious health problem in the southern part of the United States. An active eradication program in the United States had almost achieved complete extinction of the disease when the disturbed conditions of World War II and the return of soldiers from heavily infected areas resulted in an increase in cases and deaths. But decline is again in progress: In 1953 only 1,310 cases were reported, and the death rate was estimated to be less than 0.05 per 100,000 population.

The XIV Pan American Sanitary Conference recommended that "the Pan American Sanitary Bureau promote the intensification and coordination of antimalaria work, with a view to achieving the eradication of this disease in the Western Hemisphere; and that the Member Governments should convert all control programs into eradication campaigns within the shortest possible time, so as to achieve eradication before the appearance of anophelene resistance to insecticides." To carry out this resolution, a malaria consultant has been employed; headquarters for the coordination office of the malaria eradication program have been established in Mexico; countries particularly involved are undertaking active programs; and the United Nations Children's Fund is considering a major increase in appropriations for malaria eradication. Through such coordinated activities, the Americas can be made free of malaria within a short period of time. The excellent antimalaria program in the United States has shown that eradication can be achieved through collaboration of all groups concerned.

The communicable diseases of childhood continue to cause many deaths in the Americas. The death rates for whooping cough, for example, in 5 countries exceeded 30 per 100,000 population in 1952. The rates for this disease were so high in a few countries that doubt has been expressed regarding the accuracy of the statements of causes of death, for it is easy in early childhood to confuse the death due to whooping cough and bronchopneumonia with the death due to bronchopneumonia caused by other diseases. But, even though the data may not be entirely accurate, the size of the whooping cough death rates indicates the need for investigations to determine the causes and for application of preventive measures. Triple vaccine (diphtheria, pertussis, tetanus) was reported to be in use in several countries. The high value and the low cost of this method of

prevention justifies the addition and expansion of programs of immunization against whooping cough.

The International Sanitary Regulations lists six diseases as quarantinable—cholera, plague, louse-borne relapsing fever, smallpox, typhus (louse-borne), and yellow fever. Smallpox continues to occur in several countries, and the case rates in Peru, Bolivia, and Colombia are relatively high. In Colombia, for example, 7,146 cases were reported in 1954. Fortunately, fatality rates for smallpox are generally quite low, indicating that the virus has relatively low virulence. In the light of existing knowledge about smallpox control and about methods of vaccine production and preservation, there is little excuse for continued appearance of this disease. Cases of plague or deaths from this disease occurred in 8 countries in the 4-year period 1950–53, and cases of or deaths from louse-borne typhus were reported in several countries.

Progress in the control of yellow fever and in eradication of the *Aedes aegypti* has been highly gratifying in several countries. In fact, in six, eradication of the insect vector of urban yellow fever is either complete or in sight. In too many countries, however, much remains to be done. The *A. aegypti* is still present, for example, in many southern States of the United States. Perhaps not enough publicity has been given to the fact that the infested States have been officially reported by the United States Government to the World Health Organization as a yellow fever receptive area. The development in 1954 of yellow fever in Trinidad, an island heavily infested with the *A. aegypti*, and the northern extension of jungle yellow fever in Central America have been reminders that the insect vector must be eradicated from every area in the Americas if the threat of yellow fever is to be eliminated.

Table 4. Malaria and whooping cough death rates per 100,000 population in 20 American countries, 1952

Country	Malaria death rate	Whooping cough death rate
Argentina	0. 0	1. 4
Bolivia	64. 1	13. 9
Brazil [1]	7. 5	6. 3
Canada [2]	0. 0	1. 0
Chile	0. 0	8. 5
Colombia	23. 9	34. 6
Costa Rica	37. 5	14. 6
Dominican Republic	100. 1	2. 1
Ecuador [3]	16. 9	9. 8
El Salvador	71. 9	10. 9
Guatemala	233. 5	199. 0
Honduras	210. 1	51. 6
Mexico	80. 8	32. 5
Nicaragua	86. 6	19. 1
Panama	21. 8	7. 1
Paraguay [4 5]	14. 5	8. 7
Peru	18. 7	89. 9
United States	0. 0	. 3
Uruguay [5]	0. 0	2. 6
Venezuela [6]	2. 5	15. 3

[1] Federal District and State capitals, except city of São Paulo. [2] Excluding Yukon and Northwest Territories. [3] Capital cities of provinces. [4] For reporting area, 83 percent of population. [5] 1951. [6] Ill-defined causes proportionally distributed to defined causes.

From the data on the principal causes of death and also from those on the 15 communicable diseases, the very great toll the communicable diseases are taking in the Americas is evident. The success that has been attained in regard to urban yellow fever and malaria indicates that eradication of malaria and the other diseases will depend on concerted efforts to apply existing knowledge and on determination to carry through such programs.

Status of Programs and Services

In addition to data on vital events and communicable diseases, data regarding the status of the various health programs being carried on, including disease control and environmental sanitation programs, were obtained in the reports on health conditions. To illustrate these data and to stress their value in program planning, an example is taken in the field of sanitation.

The fact that the diarrheal diseases were included among the 5 leading causes of death in 12 countries is evidence of the need for improvement in environmental sanitation. The data regarding the status of one of the programs in this field, the provision of water supply systems, for 13 countries are shown in table 5. In 5 of the 11 countries providing data for urban areas, three-fourths of the urban population was served by water supply systems in 1953—

Dominican Republic, El Salvador, Panama, United States, and Venezuela. In 5 others, more than half of the urban population had water supply systems. As would be expected, the percentages of the rural population having water supply systems were very low. Despite the obvious limitations of these data, they do point out the phases of water supply programs in which international help can be of greatest importance, and they serve to stimulate individual countries to raise standards to constantly higher levels.

Table 5. Percentage of population served [1] by water supply systems in urban and rural areas in 13 American countries, 1953

Country	Total	Urban	Rural
Argentina	43	67	2
Bolivia	-------	57	-------
Canada	64	-------	-------
Chile	-------	72	-------
Colombia	23	62	1
Dominican Republic	28	88	10
El Salvador	-------	85	-------
Mexico	41	-------	-------
Nicaragua	9	27	0
Panama	52	75	37
Peru	30	60	10
United States	59	89	[2] 23
Venezuela	-------	88	-------

[1] Percentages of population calculated using total population living in area.
[2] Communities of less than 5,000 population with water supply systems.

Although some information was provided regarding the organization of health services and personnel employed, summarization of the material for presentation here is difficult. In general, it can be said that the data indicated a shortage of trained personnel, an absence of full-time health departments, and the necessity for data to evaluate resources as well as needs for health services.

Summary

Selected data from reports of the American countries, which were prepared for the XIV Pan American Sanitary Conference, have been presented to illustrate existing knowledge regarding health conditions and health services. Shortcomings of the data are great, but the very act of providing the data that are available has been a powerful impetus to improved reporting as well as to improved health programs.

In most of the American countries, there is a need for emphasis on communicable disease control and eradication and on programs for the predominantly young population. National initiative, along with the coordinated efforts of international collaboration, can solve these problems, as it has others. Through full utilization of the basic data on health conditions that appear in the Summary of Reports of the Member States, 1950–53, the countries of the Western Hemisphere, working together, will now go forward in eradicating communicable diseases, developing environmental health programs, providing maternal and child health services, improving case reporting and vital statistics systems and basic data in other programs, and in the overall strengthening of health services.

A psychologist concludes that more light would be shed by understanding human behavior factors than from complicated statistical analyses of the uncontrolled world surrounding accidents in everyday circumstances.

The Illusive Phenomena in Accident Proneness

By WILSE B. WEBB, Ph.D.

How shall we determine the presence or extent of accident proneness?

Granted the factor of accident proneness, how shall we come to know its character?

This, in a sense, will be a consumer's report—a report of occasionally desperate attempts to apply the cool logic of statistics to the fetid jungles of accident data. It is the result of some 5 years of delving into innumerable accident records (*1–3*). This faint blaze on my back tracks may help others avoid some of the morasses in which I have floundered on a number of occasions.

Dr. Webb, head of the Aviation Psychology Laboratory, United States Naval School of Aviation Medicine, Pensacola, Fla., was formerly an assistant professor of psychology, University of Tennessee and Washington University, and visiting lecturer, University of Southern California. During World War II he was a commissioned research psychologist. Since then, on contract, he has directed research in aircraft accidents, for the Air Force, and in the selection and training of aviators, for the Office of Naval Research. Dr. Webb is associate editor of Psychological Reports and the author of some 50 papers in professional journals.

The Extent of Accident Proneness

In view of the wide use and frequent abuse of the term "accident proneness," it would appear to be a required first step that I outline my concept of its meaning.

I conceive of an accident as a condition of liability, as an event subject to and contingent upon the existence of identifiable, at least in a theoretical sense, events.

This position would contend that a constellation of circumstances at the time of an accident determines the occurrence of that accident. Further, the presence of certain events increases or decreases the probability of any given accident. The summation of the probabilities represents accident liability at any given time. Finally, the position maintains that a knowledge of all of the pertinent events prior to the accident permits the prediction that the accident will occur. It, of course, follows as a corollary that increasing knowledge about the factors surrounding an accident will permit its prediction, or, if such factors are manipulatable, will permit the reduction of accidents.

Here is an expository categorization of events which may be called the dimensions of accident liability.

Factors within individual:

Stable individual characteristics (accident proneness). *Examples:* psychomotor capacities, intellective capacities, sensory capacities.

Transitory individual characteristics. *Examples:* fatigue, illness, hangovers, emotional states.

Changeable individual characteristics. *Examples:* low level of training, faulty training.

Factors outside individual:

Stimulus presentation. *Examples:* clarity of cues for response, speed of cue presentation, sequence of cue presentation.

Response demands. *Examples:* speed of response, direction of response, accuracy of response.

Equipment adequacy. *Examples:* materiel failure, calibration errors, response lag.

Activities of others. *Examples:* faulty maintenance, faulty instruction.

Consider accident proneness as a component part of this accident liability. Accident proneness, in these conditions of accident liability, is that category concerned with the stable characteristics within the individual. The other categories obviously could not be considered as proneness on the part of the individual since they either are not stable or not directly under the control of the individual.

Accident proneness, then, may be defined as the continuing or consistent tendency of a person to have accidents as a result of his stable response tendencies. For example, two individuals may fly in the same aircraft and in identical circumstances. Thus, they would have the same situational probability of having an accident. However, one may be inherently a poor pilot in regard to coordinative capacities. He will have, because of this lack of proficiency, a greater probability of having an accident in circumstances requiring coordination. He would then be called an accident-prone pilot.

How may we detect the presence of accident proneness in a population of accidents? Let us recognize certain conditions inherent in our definition of accident proneness. First, it has been described as a continuing factor, and, second, it has been described as increasing the liability of accident occurrence. It follows, then, that, if a group of individuals with varying amounts of accident proneness were exposed to conditions which permitted the operation of these factors of proneness, the accidents of those individuals with high accident proneness would exceed beyond chance expectancy the accidents of those with low accident proneness, other things being equal. The problem is simply one of establishing the fact that certain individuals had accidents which exceeded those expected on the basis of chance, other things being equal.

The Poisson Method

Perhaps the most classical method is the Poisson method (*4*, *5*). The method reveals the statistical problem as a relatively simple one. Given a relatively infrequent event, how will these events be distributed by chance alone? If such a distribution can be derived, a comparison may be made with an obtained distribution of accidents. If the distributions differ, an inference about the operation of nonchance factors may be introduced.

Thus, if 100 accidents are going to be distributed by chance among 10,000 people over a period of 1 year, what are the chances of these accidents occurring to 100 different people as contrasted with some individuals having 2 accidents, some only 1, and some none; or, some individuals having as many as 3 or 4 accidents, some having 2, some having 1, and some having none? Given a chance distribution, how does it compare with the actual distribution of accidents under consideration?

Mathematically, the Poisson distribution, which is merely the binomial distribution with low probability of occurrence, can be used to describe the chance distribution of infrequent events. If the distribution of accident events deviates from that expected on the basis of the prediction of the Poisson distribution, we may state that a beyond-chance factor is operating. This technique has been so sharpened that we may actually estimate the amount of predictable variance which exists above and beyond chance and may further estimate a correlation which could be obtained between perfect predictors and this variance in excess of chance.

The accompanying table presents a mathematically derived chance distribution and an obtained distribution of 7,288 accidents occur-

ring to 17,952 Air Force pilots during an 8-year period (*2*). Let us consider this table.

According to the Poisson method

Number of accidents	Chance distribution		Obtained distribution	
	Number of pilots	Number of accidents of pilots	Number of pilots	Number of accidents of pilots
0	11, 962	0	12, 475	0
1	4, 856	4, 856	4, 117	4, 117
2	986	1, 972	1, 016	2, 032
3	133	399	269	807
4	14	56	53	212
5	1	5	14	70
6	0	0	6	36
7	0	0	2	14

First, in regard to the chance distribution, if merely the repetition of an accident is to be taken as the definition of accident proneness, some 33 percent of the accidents could be so classified in a completely chance distribution. This is patently absurd.

Second, a casual comparison reveals that the obtained distribution contains individuals who did have accidents in excess of the distribution to be expected by chance. Only 1 pilot would have been expected to have had 5 accidents during this period on the basis of a chance distribution. In actuality, 14 had as many as 5 accidents. None would have been expected to have had 6 accidents if these accidents had been distributed on the basis of chance. In the obtained distribution some 6 individuals had as many as 6 accidents.

A comparison by the chi-square technique indicates the two distributions are significantly different. We must, however, reserve judgment as to the possibilities of inferring that this excess of chance occurrence can be attributed to accident proneness.

The Split-Period Method

Perhaps the most straightforward test of the consistency of accident tendencies over a period of time is the "split-period method." This is based on the determination of the relationship between a number of accidents had by individuals in 2 periods of time. The simplest method is to divide the total period of accident exposure into 2 halves and then determine if there is a relationship between the accidents had by individuals in the 2 periods. The statistical tool would be the correlation coefficient. In actual procedure, the time period is more typically divided into accidents occurring in odd and even periods in contrast to a first-half, last-half division so as to obtain better control of the external characteristics of the time periods.

A distribution of accidents on odd and even days, according to the split-period method, was obtained for the same Air Force population referred to previously. The obtained correlation is 0.107 and is correctable by a Spearman-Brown formula to 0.193 (*2*).

Since a correlation expresses the degree of relationship between two sets of measures, these figures indicate the degree to which the accidents had by a man during one period were related to the accidents he had in a second period. A correlation of 1.00 would indicate that the accidents during one period perfectly predicted the accidents in another period, or, one could infer there was a direct relationship between a man's accident behavior during the two periods of time. A 0.00 correlation would indicate that his accident behavior in the two periods was completely unrelated. The correlations obtained were small but significant, and it would be concluded that some beyond-chance factors were operative in the Air Force population.

It should be noted in passing that there has been, on occasion, differential touting of the Poisson method and the split-period method (*6–8*). It seems appropriate to point out that Jones and I (*9*) have shown that the two methods, derived from essentially independent assumptions, yield operationally identical estimates. We also found that mathematically the identity of the methods can be demonstrated. Practically, it would appear that the choice of the method becomes dependent only on convenience, ease of conceptualization, or personal preference.

External Correlation Method

A further statistical procedure establishing the presence of accident proneness may be la-

beled the "method of external correlation." This procedure would be dependent on the selection of a measure presumably related to accident proneness. The population would then be measured on this factor, and then these measures would be correlated against the accident occurrence. If this correlation was significant, it would indicate that accidents could be predicted on assumption of accident proneness, and, therefore, accident proneness could be inferred as existent. For example, suppose a measure of intelligence can be shown to be related to accident frequency. Since intelligence is a stable characteristic of the individual, it follows that accidents are to some extent a function of individual accident proneness as partially measured by intelligence.

Limitations of Methods

All of these procedures have their difficulties, however. The prime difficulty lies in the fact that the beyond-chance factors which may be demonstrated by these methods may not be attributed to the existence of a continuing factor of accident proneness alone. A considerable portion of the liability conditions outlined previously may exist commonly with the individual but not be attributed to his own within-person proclivities for accidents.

For example, 2 individuals with precisely the same capacities or proneness potential may be assigned throughout the accident period to 2 different situations which require different complexities of response. The individual who is consistently required to respond more effectively is likely to make more errors, and accidents would be more frequent throughout the situation, and yet he could hardly be considered more accident prone—consistently more accident liable, yes, but not more accident prone. In fact, quite frequently the converse is true since better men are frequently assigned to more difficult situations. Or, again, frequency of exposure may be different for different individuals during the accident period. A man exposed twice as frequently as another man is likely to have more accidents, but again this could not be called accident proneness.

All instance variations in liability throughout the period under study will result in beyond-chance distributions, if they are systematically associated with certain individuals and not with others. It follows that the extent to which all factors, other than the accident-prone factors which are included in the listing of the dimensions of liability, are equalized among the population under consideration defines the extent to which the deviation from chance established by the methods described can be attributed to accident proneness.

As a point of fact, with each increasing restriction on the Air Force population previously used, there was a reduction in the significance of deviation from chance. Until, for example, training accidents (which impose maximum restriction in regard to age, training, exposure, and type of aircraft) revealed no deviation in their accident repetition from that which would be expected by chance. The same holds true for selected groups of jet accidents in which exposure was largely equalized (*2*).

The Clinical Method

One further method may be mentioned as a tool for probing the existence of accident proneness. It is not statistical, but may be described as the "clinical method," a method which involves very simply a post hoc detailed analysis of the characteristics of individual accidents and individual accident histories. If, for example, a man consistently has the same type of accident under varying circumstances, and these accidents may be attributed to some characteristic inherent in that man, at least these accidents and perhaps others are attributable to accident proneness.

The clinical method has its advantages and disadvantages, which have been, and are being, argued independent of the present problem. It yields no satisfactory estimate of the extent of accident proneness. I am somewhat frightened by the "seek and ye shall find" phenomena. In the typical complexity of the accident situation I can almost always find that which I am looking for if I know what I am looking for in the first place.

Perhaps the main advantage inherent in this procedure is the liveliness and convincing quality of the results and its usefulness in developing hypotheses to be further investigated.

The Nature of Accident Proneness

Let us assume that either on the basis of faith or fact we are convinced a significant proportion of accidents is determined by accident proneness in a particular population. What do we do next? The mere pointing to the fact of accident proneness is hardly more useful than pointing to sin. We must somehow know its characteristics to be able to deal with it.

Our basic paradigm is not difficult to conceive. We need measures which are presumably related to this intervening concept of accident proneness. We need measures of the accident event. Finally, we need to determine whether our measures of accident proneness are related to or predictive of accidents.

Certain difficulties typically follow from the nature of accidents and accident records. The definition of the accident is a difficult one, yet this is a first requirement in a reasonable test of the predictability of our concepts concerning accident proneness. It is a bit absurd to suggest that, for example, an intelligence test could predict an accident resulting from the breakdown of equipment, when this breakdown was independent of the operations of the individual. In other words, we should limit ourselves to accidents for which the operator could at least theoretically be held responsible.

Unfortunately, even a simple dichotomy of accidents into personal responsibility and nonresponsibility is frequently unreliable. When we further try to dimensionalize accidents within a personal responsibility category, vast confusion tends to reign. Not long ago, on reviewing psychological coding systems for accidents, DuBois and I found that the commonality of classification of the nature of the accident usually ranged from about 33 percent agreement between 2 raters to a maximum of about 70 percent agreement between the 2 raters (*3*). The variations seem to be primarily related more to the number of possible categories to which the accident could be assigned than to any descriptive nature of the codings used. So long as the definition of an accident is not at all clear—and to date I know of no satisfactory, psychologically meaningful dimensionalization of this event—our designs will be weak.

On the other end, there are many problems inherent in obtaining measures which we are to relate to this chaos. Most of the problems at this end stem from the fact that accidents are infrequent phenomena. This means that, if measures are to be collected prior to the occurrence of an accident, the data collection must be an extensive one. Frequently, as many as 10,000 measures must be obtained on a population in order to yield measures on 10 individuals who are going to have accidents. An alternative procedure is the measurement of a limited number of individuals and then waiting for the passage of an extensive period of time until the low probability of accidents yields sufficient cases. This procedure is further complicated on finding that the measures taken may be quite meaningless by the time the accident occurs. Then, there is the post hoc method, the method of obtaining data after the accident has occurred. This method contains all of the faults of a posteriori reasoning noted in the clinical method.

Although there are ways around these problems, one becomes discouraged. Faith, frustration, tolerance, or funds are necessary to sustain us through the travails involved. There is also, of course, the question of what measures should be used, which involves an appraisal of the state of psychology itself. I will merely understate the case by saying that much more needs to be known about the nature of man.

The most adequate studies of the role of psychological factors in the development of errorful behavior, in short, a study of accident proneness, will best be performed in the laboratory situation even though there are inherent difficulties in translating laboratory findings to the operating situation. However, I personally feel that these difficulties will be far less the difficulties inherent in the rough and ready analysis required of the present complexities of the uncontrolled world surrounding operational accidents.

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Nursing Home Project Approved

The first project to be constructed under the provisions of the Medical Facilities Survey and Construction Act of 1954 (P. L. 482, 84th Cong.) has been approved.

It is a 53-bed nursing home addition to the Pinal County General Hospital at Florence, Ariz., which will be used for nursing and medical care of the aged, and will be operated by the hospital.

At present, there are no nursing home facilities in the county, and patients who could be cared for in a nursing home are occupying more than 12 percent of the 86 beds in the general hospital. The nursing home will use the hospital's special services and personnel and will, when necessary, transfer patients to the hospital for medical or surgical treatment.

Estimated construction cost of the nursing home is $240,000, toward which the Federal Government will contribute half and Pinal County the other half.

Parasitism in Southeastern United States

a symposium

The program of the Association of Southeastern Biologists, meeting in Charleston, S. C., April 21, 1955, included a symposium on parasite problems in the southeastern United States. The three papers of the symposium include a historical review by Dr. Faust, an appraisal of the progress made and the problem today by Dr. Wright, and a general summary of veterinary problems in parasitology by Dr. Bailey. The symposium moderator, Martin D. Young, Sc.D., director, Laboratory of Tropical Diseases, National Microbiological Institute, Public Health Service, Columbia, S. C., wrote the following introduction.

ABOUT three centuries ago the English successfully colonized the southeast coast of the United States. These colonists brought some exotic parasites, and later they imported slaves who also brought certain tropical parasites. In addition, the colonists encountered native parasites in the indigenous hosts. Confronted with a new set of epidemiological factors, the parasites behaved in different ways. Some became established to cause recurring epidemics. Others established endemic foci, of which some were to disappear gradually by attrition. Still other parasites were unable to maintain themselves in this area.

The parasites exerted a great influence upon the economic and social development of the people. Some of the more important parasitic diseases, such as malaria, were instrumental in causing the establishment of medical schools and influenced the type of culture evolved in the plantation low country, especially in the Carolinas. The investigation of hookworm disease emphasized the need for public health organizations and laid the foundation for the present-day county health systems.

Some of the parasitic diseases, namely malaria and filariasis, have virtually disappeared from this area. Others are still present. The symposium was held to review what has happened in the field of parasite problems in the southeastern United States and to estimate the current situation.

The eminent parasitologists in this symposium discuss their subjects authoritatively.

History of Human Parasitic Infections

By ERNEST CARROL FAUST, Ph.D.

A RÉSUMÉ of human infections from parasitic organisms in the southeastern United States from the earliest records until recent times is logically divided into four periods: infections in the American Indian before the coming of the white man; from the earliest colonial period until about 1850; from 1850 until the end of the 19th century; and from 1900 until recent times.

Before the Coming of the White Man

Very little is known about parasitic infections among the Indians. There is no indication that malaria was present (*1*), but by inference intestinal protozoiases must have been relatively common since they have been found in all indigenous populations in regions where surveys have been made. The Indians must have had the common intestinal roundworms (*Ascaris* and *Trichocephalus*) for the removal of which the Cherokees employed crude oil of chenopodium, obtained from the seeds of the native plant *Chenopodium ambrosioides* var. *anthelminticum*, and possibly also the rhizomes of the pinkroot, *Spigelia marilandica* (*2*). Their dogs probably harbored *Ancylostoma braziliense* and possibly *Ancylostoma caninum*, but the human hookworms are believed to have been introduced later from the Eastern Hemisphere.

When serious epidemics developed in Indian communities the inhabitants burned their homes and resettled on uncontaminated soil (*3*).

From 1607 to 1850

During early colonial days the explorers and settlers who came from Europe brought with them the white man's common contagious diseases, notably smallpox, measles, scarlet fever and tuberculosis and, to a lesser extent, vivax malaria and hookworm infection (due to *Ancylostoma duodenale*). Much more serious parasitic diseases were those imported in African slaves, including virulent tropical strains of vivax malaria, malignant falciparum malaria, the subtly developing quartan malaria, tropical hookworm infection, Bancroft's filariasis, schistosomiasis, and probably other parasitic diseases indigenous to Africa (*4*). Among the latter it may be reasonably assumed that relatively virulent strains of *Entamoeba histolytica* were introduced.

Malaria

All three species of malaria parasites found an appropriate mosquito host in the native *Anopheles quadrimaculatus*, which bred more and more prolifically as virgin soil was broken for the cultivation of rice in the Carolina lowlands and for sugar cane in the Louisiana bayou country. The malaria-infected Negro slaves served as the reservoir for infection of the mosquito. The mosquito in turn transmitted the

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parasites to other Negroes and to the white population. This situation caused rapid development of highly malarious communities. Later, with people settling in the fertile Ohio and Mississippi Valleys, malaria spread rapidly. By 1850 there were almost solid areas of intense malariousness from Baltimore south to Georgia, Alabama, and central Florida, inland to Cincinnati and St. Louis, and down to the Gulf of Mexico. From these highly endemic areas vivax malaria became established throughout almost the entire United States except for mountainous and desert regions, while the more tropical *falciparum* infection remained entrenched in the southeast (*1*).

Hookworm Infection

Human hookworm infection caused by the more tropical parasite *Necator americanus* became gradually disseminated throughout the moist sandy humus soils of the southeast, extending from Virginia to southern Illinois and down to the gulf, and as far westward as eastern Texas. Here again the Negro was the source of the infection as he polluted the soil with his excreta which contained the eggs of the parasite. After hatching and larval growth on the soil, the parasite was infective for all persons who stepped barefooted on the infested ground. Soon hookworm infection was contracted by the white laborers in areas adjacent to the bottom lands.

The earliest clinical records of hookworm disease in the United States were from Florida in 1845 and Louisiana in 1850, only a few years after Dubini described the Old World human hookworm (*A. duodenale*) from Italy and a half century before the tropical hookworm *N. americanus* was specifically described.

Other Infections

The colonists and those who later emigrated and settled inland from the Atlantic and gulf coasts were familiar with the cosmopolitan intestinal roundworms. Some species, like the pinworm *Enterobius vermicularis*, they brought with them from Europe; others, like *Ascaris lumbricoides* and *Trichocephalus trichiurus*, they may have acquired in part from the Indians, and in larger part from the Negroes who worked on the plantations. The evidence supporting these conclusions is indirect but relatively satisfactory, based on the descriptions of roundworms in the American medical texts of the late 18th and early 19th centuries and on the prescription of many native plants which were supposedly effective as intestinal vermifuges (*5*) and listed in the early editions of the United States Formulary (*Allium cepa*, *Allium sativum*, *Angelica archangelica*, *C. ambrosiodes* var. *anthelminticum*, *Convolvulus jalapa*, *Ferula assafoetida*, *Juglans regia*, *Laurus camphora*, *Melia azedarach*, *Spigelia anthelmia*, *S. marilandica*, *Tanacetum vulgare*, *Valeriana officinalis*, and *Veratrum sabadilla*). Moreover, persons who ate inadequately cooked beef must have acquired beef tapeworm (*Taenia saginata*) infection and, similarly, those who ate rare pork, infection with pork tapeworm (*Taenia solium*). Likewise, they probably became infected with *Trichinella spiralis*, which was first reported from hogs by Joseph Leidy of Philadelphia, in 1846.

Bancroft's filariasis, caused by *Wuchereria bancrofti*, was introduced in the African slaves (*4*) and became established in the domestic mosquito *Culex quinquefasciatus* as a biological vector. However, there is no information during this period as to the geographic distribution or prevalence of this disease.

Blood fluke infections, caused by *Schistosoma mansoni* and *Schistosoma haematobium*, which were likewise introduced into the Western Hemisphere in African slaves (*4*), failed to find sufficiently susceptible molluscan intermediate hosts in North America, never became established here, and did not survive the death of the human hosts who brought them into the country.

Primitive conditions for disposal of human excreta, contaminated water supplies, infrequent bathing among the laboring and even other classes, and various other defects in personal and community hygiene favored transmission and high prevalence of infections produced by the intestinal protozoa. Yet there is no direct evidence of their presence or frequency although it seems justifiable to assume that a considerable amount of the common dysentery of these decades, referred to as "bloody flux," was due to the pathogenic ameba, *E. histolytica*.

By 1850 most of the parasitic diseases of the southeast and those transmitted by arthropods or due to bacteria had reached their peak, had developed formidable plateaus of incidence, or were subject to serious periodic epidemics (*3*). At least two of our medical schools, the Medical College of South Carolina at Charleston and the Medical College of Louisiana, later named Tulane, at New Orleans, were established to train physicians to combat malaria, yellow fever, epidemic typhus fever, cholera, and endemic intestinal diseases.

Today it is readily understood that all of the environmental conditions which favor many of the infectious diseases were present during those decades in the southeastern States, namely (*a*) for malaria—newly cultivated, poorly drained land for the breeding of the anopheline mosquito vector; (*b*) for yellow fever—prevalence of *Aedes aegypti* transmitters in cisterns and other fresh water containers around the home; (*c*) for typhus fever—infrequent bathing and washing of clothes, resulting in body lice among both the poor classes and the socially elite; and (*d*) for the intestinal diseases—improper disposal of human excreta, contamination of food and drinking water, and carelessness in personal hygiene. While the slaves and poorer whites suffered most, the better educated and well-to-do persons were by no means exempt and at times had proportionately higher morbidity and mortality rates.

From 1850 to 1900

During the years 1862–65, when Northern soldiers were quartered in the South, there was a notable increase in malaria and dysentery, particularly in and around the Army camps. During this quadrennium the annual malaria morbidity rate in the Federal forces in North Carolina was 1,087 per 1,000 mean strength; in Tennessee, 848; and in the gulf area, 803 (*6*). Moreover, there were nearly 2 million reported cases of dysentery in the Northern Army, with 44,558 deaths attributed to this cause (*3*).

Following Appomatox, the South was deprived of its agricultural labor, the land remained untilled, and malaria mosquitoes bred without restraint (*1*). As late as 1881 the malaria death rate per 100,000 population was 428 in Shreveport, 318 in Vicksburg, 171 in Baton Rouge, 100 in New Orleans, and comparably high in other malarious areas of the southeast.

Epidemics of yellow fever of major or minor proportions were reported from one or more southern port cities annually from 1850 through 1900, except for 7 years—1861 (during blockade of southern ports by Federal forces), 1881, 1885, 1886, 1891, 1895, and 1896 (*7*). There were severe epidemics of dengue during 1849–60, 1873–76, 1880, and 1896–98. Between 1847 and 1853 there were about 1,200 cases of louseborne typhus fever annually in the New Orleans Charity Hospital, originating from importation of the disease from Ireland and Mexico (*8*). Cholera arrived on boats from Europe. During 1849–53 and again in 1873, it caused heavy mortality at the port of New Orleans and was spread to communities far inland through the Mississippi, Ohio, Missouri, and Platte River Valleys (*9*).

From 1900 to 1950

The etiology and natural history of many of the common parasitic and arthropod-transmitted diseases prevalent in the southeast became known during the 1890's and the following decade. These included the role of *Anopheles* in the malaria life cycle, of *A. aegypti* in urban yellow fever, and of the body louse in epidemic typhus fever. As early as 1876, Manson had demonstrated that the household mosquito *C. quinquefasciatus* was an intermediate host and vector of Bancroft's filariasis (*10*). By 1900 the life cycle of the human hookworms was likewise a matter of record (*11*), but it was not until the 1920's that specific information was provided on the epidemiology and life cycle of *Ascaris*, as well as the etiology of cutaneous larva migrans.

Amebiasis

Although *E. histolytica* had been described by Lösch in 1875 and its pathogenic role in the production of disease was conclusively demonstrated during the next 25 years by workers in Europe, Egypt, Philadelphia, Baltimore, and Texas, its life cycle involving man was first directly demonstrated in 1913 when Walker and

Sellards in the Philippines fed cysts of this ameba to 20 human volunteers and obtained infection in 18, with dysenteric symptoms in 4 (*12*). Epidemiological surveys were begun in 1913 to determine the prevalence of, and methods of exposure to, amebiasis in different groups of the population in the United States, that is, urban vs. rural, clinic patients vs. apparently well persons, children vs. adults, and institutionalized vs. noninstitutionalized groups. These studies demonstrated a higher average incidence among noninstitutionalized individuals in the southeast than in other areas, due probably to less careful personal and group hygiene (*13*).

Malaria

The first two decades of the 20th century saw considerable retreat of malaria along the northern border of the hyperendemic areas in the southeast, primarily as a result of better drainage of farmland. In contrast, there was no appreciable decrease in malariousness in the southeast (*14*). During the depression of the 1930's there were notable increases in morbidity and mortality from malaria in this area. Then widescale control was instituted by cooperation of Federal and State public health agencies, consisting of scientific drainage and other antilarval measures, screening of homes, chemotherapy, and more adequate diets among the poorer classes in the population.

Beginning in 1942 malaria vector control was carried out intensively within and around military training bases in the southeast, and, as soon as DDT was in supply, this insecticide was used effectively both as a larvicide (*15*) and an imagocide. More accurate blood film diagnosis of the malaria parasites so that malaria and typhoid fever were no longer confused (*16*), together with treatment of human carriers with quinacrine and later with chloroquine, practically terminated the chances for the remaining anophelines to pick up the infection and transmit it to other persons.

Although our local *A. quadrimaculatus* was shown to be readily susceptible to foreign strains of human plasmodia (*17*), as a result of effective control measures only a very few incidental transmission cycles developed in the United States following the return of many thousands of American troops from malarious areas during World War II, and more recently from Korea. Thus, by 1950 malaria had ceased to be a public health problem in any previously malarious area in the United States (*18*).

Hookworm Infection

Soon after the discovery and naming of the hookworm *N. americanus* in 1902 by Charles Wardell Stiles, surveys were undertaken to ascertain the clinical and public health importance of hookworm infection in the southeastern United States. It was discovered that this parasite had extensive distribution, especially in the nonmountainous areas, and was responsible for much serious illness, an appreciable number of deaths, and untold economic loss.

In 1915 the Rockefeller Foundation undertook studies in the southeast to obtain more exact epidemiological information, with the objective of developing effective control (*19*). In cooperation with State public health agencies all of the endemic areas were surveyed, after which anthelmintic treatment was administered to the hundreds of thousands of infected individuals (*20*). Sanitary methods for disposal of human excreta were instituted, and education concerning hookworm epidemiology and its prevention became a part of the public health programs of all communities in which the disease was prevalent.

These measures were successful in reducing the heavy hookworm burden in all but a few localities (*21*) although incidental hookworm infection remained throughout much of the previously heavily endemic area (*22*).

Cutaneous Larva Migrans

The disease, cutaneous larva migrans or creeping eruption, is restricted mostly to the South Atlantic and the gulf coasts, particularly on both coasts of northern Florida. Clinical and experimental studies of Kirby-Smith and associates between 1917 and 1927 demonstrated that the etiological agent is a nonhuman strain of *A. braziliense*, exposure to which occurs when persons lie on beaches or otherwise come in contact with the infective-stage larvae in places where dogs or cats harboring the adult worms have previously defecated (*23*).

Ascariasis

Inquiry into the geographic distribution and epidemiology of ascariasis was undertaken in 1927 by Cort and his associates, a few years after the life cycle of the etiological agent, *A. lumbricoides*, had been elucidated by Ransom and his associates (*24*, *25*). It was found that in the southeastern United States this was fundamentally an infection of young children, who seeded the dooryard with *Ascaris* eggs (*26*). Later, the same children and their playmates became infected by getting the embryonated eggs in their mouths—eating contaminated soil on play objects or fingers and then swallowing the eggs. With a few notable exceptions, ascariasis in the southeast was found to be predominantly prevalent in the southern extensions of the Appalachian highlands. Headlee (*27*), who studied the epidemiology of ascariasis in New Orleans, emphasized that it is primarily a familial infection. Up to 1950 no sustained or extensive programs had been undertaken to control this infection.

Visceral Larva Migrans

The dog ascarid, *Toxocara canis*, has been found to produce a serious childhood disease designated as visceral larva migrans. When a child swallows fully embryonated eggs of this parasite, the eggs hatch in the child's duodenum and undertake a lung journey, just as occurs in human *Ascaris* infection. However, since man is not a particularly suitable host for the dog ascarid, granulomatous tissue reaction almost invariably traps the migrating larvae, most frequently in the liver, but at times in other organs and tissues. A pronounced sensitization reaction results, with prolonged high eosinophilia. The infection is incapacitating but not usually fatal. Discovery of the etiology of this disease (in New Orleans) has been so recent that its prevalence and geographic extent are essentially undetermined (*28*).

Strongyloidiasis

Strongyloides stercoralis is prevalent in warm moist climates; in the United States it occurs mostly in the gulf coast areas where there is a relatively high ground water level, as in the bayou country of Louisiana (*29*); elsewhere throughout most of the southeast the infection is relatively sporadic. This nematode is biologically interesting since under favorable conditions it can carry out one or more complete life cycles as a free-living organism on the soil, while at other times it propagates exclusively by internal autoinfection (*30*).

Whipworm Infection

In connection with epidemiological studies on hookworm and *Ascaris*, infection with the whipworm, *T. trichiurus*, has been found to be widely disseminated in the southeast (*31*, *22*). Most reports indicate that the average worm burden is relatively light, but young patients living in unsanitary rural environments occasionally have a high worm burden, with dysentery and other manifestations of severe colitis.

Enterobiasis

Infection with the pinworm, *E. vermicularis*, is common in children throughout the southeast, but is no more prevalent here than it is in cooler climates. The development of the NIH swab (cellophane) and more recently of the Graham swab (scotch tape) for recovery of the eggs deposited by the female worms migrating outside the anus, has provided much easier and more accurate diagnosis than fecal examination for eggs (*32*). In our area as elsewhere the infection is primarily familial or institutional.

Trichinosis

Surveys to determine the incidence of human infection with *T. spiralis* have been conducted in several localities in the southeast, usually employing digestion or pressed muscle examination of routine necropsies to demonstrate the larval stage. The percentage of positive cases has been relatively low (2.8 to 10.0) save for one report of 33.0 from Alabama. With few exceptions the larval count per gram of infected muscle has likewise been low (*33*, *34*). This corresponds to the clinical findings in the southeast where the infection rarely produces severe manifestations.

Tapeworm Infections

The beef tapeworm, *T. saginata*, has become considerably less prevalent than it was 25 years ago, and the pork tapeworm, *T. solium*, has

practically disappeared from the native population of the United States. In contrast, both of these infections are increasingly common in continental Latin America.

The dwarf tapeworm, *Hymenolepis nana*, which requires no intermediate host and results from poor personal hygiene and lack of environmental sanitation, is widely distributed in the southeast and is most often found in children (*35*). Occasionally patients are so heavily parasitized that they are seriously ill as a result of these worms.

Human infection with the fish tapeworm, *Diphyllobothrium latum*, has been demonstrated to be indigenous in only one locality in the southeast, a rural community in Florida, where Negro boys and their dogs harbor the adult worms (*36*). The larval stage (sparganum) of a related tapeworm, *Diphyllobothrium mansoni* complex, producing somatic infection in man (sparganosis) has been reported in earlier decades—once from Florida and once from Texas. Recently, eight new cases have been discovered in Louisiana, Mississippi, and eastern Texas. As in fish tapeworm infection, species of *Cyclops* are the first intermediate host of the parasite, while frogs, snakes, birds, and mammals, but never fishes, are the second larval-stage hosts, and cats or dogs are the natural definitive hosts of this tapeworm. There is no specific evidence as to how man acquires the infection, but it seems likely from the case histories that he drank unfiltered water containing infected *Cyclops*.

Hydatid disease, produced by the larval stage of *Echinococcus granulosus*, has been demonstrated to be an autochthonous human infection in Virginia, Tennessee, Mississippi, and Louisiana.

Filariasis

During the 18th and 19th centuries Bancroft's filariasis may have been widely distributed throughout the southeast although there is no authentic record of the demonstration of the etiological agent, *W. bancrofti*. Charleston, S. C., was found to be an endemic center during blood surveys conducted in 1886, 1890, and 1915. Between 1915 and 1918 Edward Francis of the Public Health Service examined human blood films in 10 southern cities (Charleston, Columbia, Beaufort, and Georgetown, S. C.; Savannah and Milledgeville, Ga.; Jacksonville and Tampa, Fla.; Mobile, Ala.; and New Orleans, La.) to determine the extent of the infection. Only in Charleston were positive individuals discovered (13 to 35 percent of inmates of the old folks' home) who had maintained residence exclusively in the United States.

Since the publication of Francis' report (*37*), the writer has learned of only one authentic diagnosis of an autochthonous case—in 1930 in a native of Georgia who was for a time a patient of the Public Health Service Hospital at Carville, La. The lack of any subsequent reliable reports of cases suggests that Bancroft's filariasis has disappeared from the southeast. Meanwhile there have been three recent findings of immature female filariae from subcutaneous nodules of white persons with long residence in Florida. While these worms conform to the criteria for *Dirofilaria conjunctivae*, it seems reasonable to believe that they are in reality young specimens of the dog filaria, *Dirofilaria immitis*, which were unable to complete their development in man (*38*).

Summary and Conclusions

The parasite problems of the southeastern United States have been presented from the perspective of history and epidemiology. Some of the common intestinal roundworms and probably most of the intestinal protozoa were indigenous in the American Indian. Other animal parasites were introduced from Europe by the explorers and colonists although diseases among them were relatively unimportant compared with the contagious diseases of viral and bacterial origin which were brought to the Americas. Many serious problems developed with the importation of slaves from Africa and the consequent propagation in the favorable environment of the southeast of tropical strains of malaria parasites and the hookworm *Necator americanus*. As families from the Atlantic and gulf coast areas settled in the fertile inland valleys, these and other parasitic diseases became more extensively distributed. Poor conditions of sanitation and primitive personal hygiene made of the entire southeast a hyperen-

demic area for a number of diseases of parasitic origin, of others transmitted by arthropods, and those caused by enteric bacteria.

With the discovery of the etiological agents and knowledge of their life cycles and their methods of transmission, came improvement in water supplies, drainage, and disposal of human excreta. Public health programs were instituted to control these diseases. Parasite control in the southeast presents less of a problem now than it did in 1850 or 1900.

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EDITOR'S NOTE: The term, "*Trichocephalus trichiurus*," used in the above paper is synonymous with the term, "*Trichuris trichiura*," in the other papers of this symposium.

Special Committee on Medical Research

A Special Committee on Medical Research has been named by the National Science Foundation to review and evaluate the medical research program of the Department of Health, Education, and Welfare.

In requesting the review, the Secretary of Health, Education, and Welfare asked that the committee consider the rate of growth of the Department's health, medical, and related research program in the light of Federal responsibilities and appraise its present level of medical research support. Careful consideration was also requested of the proper balance of support for basic and applied research and the relative distribution of effort among the major special fields of health research.

The special committee is headed by Dr. C. N. H. Long, chairman, department of physiology, Yale University School of Medicine. Other members are Dr. E. A. Doisy, professor of biochemistry, St. Louis University School of Medicine; Dr. Ernest W. Goodpasture, Armed Forces Institute of Pathology, Walter Reed Army Medical Center; Dr. A. B. Hastings, department of biological chemistry, Harvard Medical School; Dr. Charles Huggins, director, the Ben May laboratory for cancer research, University of Chicago; Dr. Colin M. MacLeod, department of microbiology, New York University School of Medicine; Dr. C. Phillip Miller, department of medicine, University of Chicago; Dr. W. M. Stanley, director, virus laboratory, University of California. Dr. Joseph W. Pisani, on leave of absence from the State University College of Medicine at New York City, where he is assistant dean, is serving as executive secretary of the committee.

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Current Status of Parasitic Diseases

By WILLARD H. WRIGHT, Ph.D.

THE past few decades have witnessed a remarkable advance in public health standards in the southeastern United States, and along with this advance changes have been recorded in the incidence of most parasitic infections. Other than the virtual disappearance of malaria, to which the insecticide DDT has contributed in no small measure, most of the gains have not been associated with any spectacular medical discovery.

The decline in hookworm disease is a case in point. Stiles (*1*), who awakened the consciousness of the south concerning this disease and who was responsible for much of the early control effort, believed that the important factors in the decline in hookworm disease were associated with the advent of the automobile, good roads, better schools, industrial expansion, higher economic status, and improved sanitation. These factors are even more potent influences today than they were more than two decades ago. Regardless of the responsible elements or the operative mechanism, it is interesting to trace the changes since 1910 and to analyze the present status of human parasitic infections in this area through such data as are available.

Sources of the Data

The more recent information concerning the incidence of intestinal helminths has been placed at my disposal by the directors of the State health department laboratories or other State officials. The data for 1930–38 have been taken from the extensive surveys conducted by the department of preventive medicine of Vanderbilt University School of Medicine and summarized by Keller, Leathers, and Densen (*2*). The figures for 1910–14 are from the reports of the Rockefeller Sanitary Commission. In certain instances, material has been abstracted from reports of State health officers.

Morbidity data on amebiasis and trichinosis have been extracted from records of the National Office of Vital Statistics, Public Health Service. Information concerning the incidence of *Trichinella spiralis* represents a summary of all diaphragm examinations reported by various investigators. The material covering malaria morbidity and cases appraised during 1948–53 was compiled by the Communicable Disease Center, Public Health Service.

The validity of some of the comparisons made in this paper is subject to question because of many variable factors. The surveys were made by many different individuals and different techniques were utilized. There is no certainty that the samplings came from the same areas in the various States or that similar population groups are represented. Regardless of these limitations, a comparative presentation of data for various periods is warranted, and in many cases the comparisons are of considerable significance.

Ascaris lumbricoides

The classic report of Otto and Cort (*3*) summarized the information regarding the dis-

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tribution of *Ascaris lumbricoides* infections in the United States up to 1934. The high incidence areas were defined by these authors as the southern Appalachian plateau with its foothills and contiguous valleys, isolated areas in the coastal region of North and South Carolina, and areas in Florida, Arkansas, and central and south Louisiana. The highest incidences recorded have been from the mountainous regions of Kentucky, Virginia, and Tennessee.

The latest available data on the incidence of *A. lumbricoides* infections in certain southeastern States are summarized in table 1. The figure for Kentucky is strikingly higher than that for any other State, and Florida and Louisiana follow in order. These figures are then consonant for the most part with the summation of Otto and Cort 20 years ago.

A comparison between the recent incidence of ascariasis in various southeastern States and the data for 1929–38 also appear in table 1. The data indicate a decided improvement in the situation with regard to this parasite except in Florida, which now shows a higher incidence than that reported for 1937–38.

Zoonotic Larval Ascariasis

Zoonotic larval ascariasis is also known as visceral larva migrans. During recent years a number of reports, some from the southeast, of a clinical syndrome associated with hepatomegaly and pathological foci in the liver believed to be due to invasion by ascarid larvae have appeared. In most cases an intermittent fever is present. There is usually a history of nausea, vomiting, anorexia, irritability, cough, and loss of weight. In cases with pulmonary involvement, roentgenograms may show transitory, shadowy infiltration. There is marked anemia, a striking leukocytosis, and a high eosinophilia. Liver function tests frequently show deviation from the normal. In cases in which laparotomy has been performed, the liver has been found to be studded with white plaques of scar tissue.

Perlingiero and György (*4*), Zuelzer and Apt (*5*), Mercer and associates (*6*), and Behrer (*7*) were the first to describe these cases, which have occurred mainly in young children. Most of these authors associated the condition with larvae of *A. lumbricoides*. However, Beaver and associates (*8*) were of the opinion that the three observed by them were due to the larvae of *Toxocara canis*, the most common of the two species of ascarids infecting the dog. Since that time, the larvae of the cat ascarid, *Toxocara cati*, have also been incriminated.

Wright (*9*) showed that the life cycle of *T. canis* is similar to that of *A. lumbricoides*. However, in abnormal hosts the larvae have a pronounced tendency to wander extensively in various tissues without necessarily completing the entire life cycle. According to Mendheim, Scheid, and Schmidt (*10*), the adult cat ascarid, *T. cati*, has been found 18 times in man, but only 1 authentic case involving a mature infection with the dog ascarid, *T. canis*, is on rec-

Table 1. Comparison of recent and prior data concerning the incidence of infections due to Ascaris lumbricoides in 9 southeastern States

State	Recent period [1]	Total examinations	Percent positive	Former period	Total examinations	Percent positive
Alabama	1953–54	83, 901	0. 4	1934–37	253, 630	1. 1
Florida	---do	163, 479	7. 8	1937–38	33, 185	2. 5
Georgia	---do	170, 856	2. 1	[2] 1935–36	63, 316	1. 3
Kentucky	---do	5, 756	21. 1	1934–35	[3] 23, 964	34. 7
Louisiana	---do	128, 343	4. 4			
Mississippi	1951–54	85, 362	. 9	1932–33	50, 733	1. 1
North Carolina	1953–54	36, 480	2. 6	1935–37	43, 647	11. 4
South Carolina	1951–54	25, 239	3. 8	1934–35	[3] 28, 875	4. 0
Tennessee	1950–54	23, 529	2. 7	1929–31	31, 999	27. 1

[1] As revealed by State health department laboratory examinations. [2] Georgia State Board of Health Biennial Report, 1935–36. [3] White only.

Table 2. Incidence of infections due to Trichuris trichiura in 9 southeastern States as revealed by recent and prior surveys

State	Period	Total examinations	Number positive	Percent positive	1930–38 Percent positive
Alabama	1951–52	40, 845	13	0. 03	0. 04
Florida	1953–54	163, 479	1, 441	. 9	. 4
Georgia	do	170, 856	513	. 3	. 3
Kentucky	do	5, 756	217	3. 8	10. 0
Louisiana	do	128, 343	5, 562	4. 3	
Mississippi	1951–54	85, 362	499	. 6	. 3
North Carolina	1953–54	36, 480	75	. 2	. 9
South Carolina	1951–54	25, 239			. 04
Tennessee	1950–54	23, 529	197	. 8	7. 6

ord for man. Regardless of the fact that these worms seldom develop to maturity in man, children especially are no doubt often exposed to the infective ova. The potential exposure must be considerable since it has been estimated that there are in the United States some 22 million pet dogs and 11 million domestic cats, the majority of which at one time or another probably become infected with *Toxocara*.

Although perhaps not directly related to zoonotic larval ascariasis, the cases of nematode endophthalmitis reported by Wilder (*11*) present another indictment against nematode larvae as disease agents. Wilder reported 46 cases in which nematode larvae were found in 24 of the enucleated eyes and a characteristic reaction in the other 22. With few exceptions, the 46 patients were children, the greatest number being from the southeast. While Chitwood identified the larvae as hookworm larvae, recent findings concerning conditions due to *Toxocara* larvae would leave the suspicion that perhaps these larvae are involved in cases of endophthalmitis.

Trichuris trichiura

While the general factors responsible for the transmission of *A. lumbricoides* are applicable to *Trichuris trichiura*, the ova of the latter have a much higher moisture requirement for their development and are less resistant to desiccation (*12*). The incidence of *T. trichiura* infection is usually higher in tropical and subtropical areas with heavy rainfall than in the temperate zones, where conditions in the external environment are less favorable for the ova. Even in the mountains of Kentucky, where conditions were once extremely favorable for transmission of both parasites, Keller and Leathers (*13*) obtained an incidence of 40.8 percent for *A. lumbricoides* and an incidence of only 12.1 percent for *T. trichiura* infections. Recent data concerning the occurrence of the latter parasite in certain southeastern States and data for 1930–38 are shown in table 2. Relatively low indexes were recorded in all States represented, with the highest recent incidence in Louisiana. The relatively heavy rainfall and high humidity in parts of Louisiana may provide favorable conditions for the development of the ova of this parasite.

Hookworm Infection

At one time hookworm disease constituted a serious public health problem in the southeast and was responsible for much physical and mental retardation. The current incidence is relatively low (table 3). Florida shows the highest incidence of all southeastern States represented, followed in immediate order by Georgia, North Carolina, and Alabama. The marked reduction which has taken place in the incidence of hookworm infection since 1910–14, the days of the Rockefeller Sanitary Commission and since the survey conducted by Vanderbilt University in the 1930's is shown in table 4. It is not possible to arrive at any definitive evaluation concerning changes in the intensity of the infection over the past 40 years because efforts to ascertain the relative worm burden

were not made during the 1910–14 surveys nor are such data available for the recent period. However, the available evidence would indicate that there has been over the period in question a marked reduction in the worm burden. Keller, Leathers, and Densen (*2*) found that about one-fourth of the individuals in their 1930–38 surveys had infections sufficiently severe to produce clinical symptoms. Hood (*14*) stated that in Florida there had been a marked diminution in the intensity of infection during the 10 years previous, and noted that in western Florida only 7.7 percent of infected children had moderate to heavy infections. Hosty and co-workers (*15*) stated that in Alabama the typical clinical case is rarely seen.

Table 3. Incidence of hookworm infection in 9 southeastern States as revealed by examinations by State health department laboratories

State	Period	Number of examinations	Number positive	Percent positive
Alabama	1953–54	83, 901	9, 936	11. 8
Florida	do	163, 479	30, 844	18. 9
Georgia	do	170, 856	29, 231	17. 1
Kentucky	do	5, 756	217	3. 8
Louisiana	do	128, 343	5, 106	4. 0
Mississippi	1951–54	85, 362	5, 406	6. 3
North Carolina	1953–54	36, 480	4, 665	12. 8
South Carolina	1951–54	25, 239	2, 022	8. 0
Tennessee	1950–54	23, 529	460	2. 0

Creeping Eruption

Creeping eruption is an annoying but not a serious condition caused by the migration, through the skin, of infective larvae of the dog and cat hookworm, *Ancylostoma braziliense*. It occasionally comes to maturity in man in certain parts of the tropics. The condition is associated with papular formation and tortuous or serpiginous, subepithelial burrows with later vesiculation. The larvae may continue to migrate for weeks or months. Infection is contracted when parts of the body come in contact with infested soil.

Since creeping eruption is not a reportable disease, the frequency of its occurrence is not known. However, physicians along the south Atlantic and gulf coasts are called upon to treat many cases annually. In 1949 Donaldson, Steele, and Scatterday (*16*) sent questionnaires to 1,100 Florida physicians, of whom approximately 50 percent replied. These physicians had seen, within a 6-month period, more than 8,000 cases of the disease. These authors conducted surveys of hookworm infection in dogs and cats in Florida; of 495 dogs examined 44.2 percent were infected with *A. braziliense*. Seven of 26 cats were positive. Of the 495 dogs, 86.1 percent carried one or both hookworm species, *A. braziliense* and *Ancylostoma caninum*. The larvae of the latter species may also be involved in the causation of creeping eruption. The opportunities for exposure to dog and cat hookworm larvae would seem to be exceptionally good, particularly along the Atlantic and gulf beaches.

Amebiasis

In 1950, Wright reported on the public health status of amebiasis in the United States and pointed out the factors which account for a considerable variability in reporting (*17*). Because of these factors, there is some question whether morbidity reports accurately reflect the occurrence of the disease. At that time it was pointed out that amebiasis was more prevalent in the West South Central States, Arkansas, Louisiana, Oklahoma, and Texas, than in any other part of the United States. There was also evidence that the disease was more widespread in the southern States as a

Table 4. Comparison of recent and prior data on the incidence of hookworm infection by percentage found positive in 8 southeastern States

State	1910–14 [1]	1930–38 [2]	1950–54 [3]
Alabama	41. 0	17. 7	11. 8
Florida	61. 8	34. 8	18. 9
Georgia	65. 2	31. 6	17. 1
Kentucky	37. 4	8. 5	3. 8
Mississippi	53. 0	19. 6	6. 3
North Carolina	36. 6	12. 3	12. 8
South Carolina	37. 3	24. 8	8. 0
Tennessee	25. 4	6. 8	2. 0

[1] Rockefeller Sanitary Commission surveys. [2] Reference 2. [3] State health department laboratories. For exact dates of survey, see table 3.

Table 5. Reports of cases of amebiasis in 10 southeastern States for various years

State	Number of cases					
	1933	1940	1950	1951	1952	1953
Alabama	8	6	45	31	18	46
Florida	33	37	113	88	161	177
Georgia	70	99	37	15	18	21
Kentucky	0	10	33	0	7	0
Louisiana	41	43	339	155	124	85
Mississippi	892	1,797	121	177	92	81
North Carolina	N. N.	N. N.	132	96	44	31
South Carolina	1	6	6	0	4	4
Tennessee	11	23	102	90	144	60
Virginia	14	11	10	4	8	20
Total	1,070	2,032	938	656	620	525

N. N.=Not notifiable.

Table 6. Surveys for Entamoeba histolytica in various population groups in certain southeastern States prior to 1945

Survey group	Number examined	Number positive	Percent positive	Date	Locality	Author
Inpatients and outpatients						
Private patients	1,003	55	5.5	1933	Atlanta, Ga	Dougherty.
Clinic patients	1,100	158	14.4	1934	New Orleans, La	Faust.
Do	4,270	355	8.3	1936	do	Faust and Headlee.
Outpatients	2,265	77	3.4	1939	do	Moss.
Patients with colonic symptoms.	236	68	28.8	1943	do	D'Antoni.
Total	8,874	713	8.0			
General population						
Rural population	460	92	20.0	1930	Virginia	Faust.
Do	4,987	861	17.3	1930	Tennessee	Meleney.
Do	374	136	36.4	1931	do	Milan and Meleney.
General population	20,237	2,305	10.1	1932	do	Meleney et al.
Students	729	38	5.2	1936	Athens, Ga	Byrd.
Persons on relief	537	33	6.1			
Rural population	322	66	20.5	1936	Georgia	Seckinger.
Students	291	9	3.1	1938	New Orleans, La	Swartzwelder.
Airline personnel and others	566	42	7.4	1939	Jacksonville, Fla	Borland.
Accident autopsies	202	13	6.4	1941	New Orleans, La	Faust.
Students	181	15	8.3	1942	do	Do.
Do	2,393	119	5.0	1942	Berea, Ky	Headlee and Cable.
Total	31,279	3,729	11.9			
Institutions						
Orphanage	119	66	55.5	1931	New Orleans, La	Faust.
Mental hospital	70	28	40.0	1941	Milledgeville, Ga	Reardon.
Do	142	5	3.5	1941	Columbia, S. C	Young and Ham.
Industrial school	188	8	4.3	1942	Jacksonville, Fla	Summers.
Newly admitted mental patients.	637	11	1.7	1943	Columbia, S. C	Burrows.
Mental patients	1,418	116	8.2			
Total	2,574	234	9.1			
Grand total	42,727	4,676	10.9			

whole than in any other section, with the possible exception of the Pacific Coast States.

The number of cases reported in certain southeastern States for various years since 1933 when the occurrence of the disease was first recorded by the Public Health Service is presented in table 5. If these figures could be relied upon at all, they would indicate a gradual reduction of cases in this part of the country. The erratic figures from Mississippi are accounted for by a change in reporting methods in 1947; reports prior to that time were probably inaccurate.

The results of stool surveys for *Entamoeba histolytica* in various population groups in the southeastern States prior to 1945 (table 6), may be compared with the findings of such surveys carried out since 1945 (table 7). Table 8 summarizes the data in tables 6 and 7. The overall incidence of the parasite prior to 1945 was 10.9 percent and that from 1945 to 1954 was 10.5 percent. Thus, insofar as stool examinations are concerned, there is no indication of any marked decline in the incidence of the infection in the population of the southeastern States within the past 10 years. These data are certainly not in conformity with the morbidity reports. Several explanations might be offered to account for this discrepancy, but since no factual data are available to support any one of them, they would constitute mere speculations.

Restudy of Intestinal Parasites

Because of the numerous variables which are recognized as influencing certain comparisons in this presentation, it is of interest to review the data presented by Jones, Smith, and Eyles (*18*) concerning a restudy of intestinal parasitic infections in a Tennessee community 21 years after a previous survey. Jones was responsible for the technical work in the recent investigation and was also largely responsible for the examinations in the 1930 survey (*19*). The samplings included many of the same people who were sampled in the former survey. Comparative findings of the principal parasites in the two periods are summarized in table 9. The figures indicate a substantial reduction in

Table 7. Recent surveys for Entamoeba histolytica in various population groups in certain southeastern States

Survey group	Number examined	Number positive	Percent positive	Date	Locality	Author
Inpatients and outpatients						
Inpatients and outpatients	246	42	17. 1	1948	Memphis, Tenn	Anderson et al.
Inpatients	2, 522	321	12. 7	1950	Winston-Salem, N. C	Mackie et al.
Veterans	878	277	31. 5			
Outpatients	926	54	5. 8	1952	Atlanta, Ga	Goldman and Johnson.
Veterans	400	37	9. 3	1954	Chamblee, Ga	Brooke et al.
Total	4, 972	731	14. 7			
General Population						
Food handlers	58	4	6. 9	1948	Chapel Hill, N. C	Larsh et al.
Rural population	2, 657	278	10. 5	1953	Fayette County, Tenn	Eyles et al.
Do	935	100	10. 7	1953	Yazoo Delta, Miss	Jones et al.
Do	322	72	22. 4	1954	New Hope, Tenn	Do.
Urban population	733	26	3. 5	1954	Memphis, Tenn	Eyles and Jones.
Mental hospital employees	191	4	2. 1	1954	Milledgeville, Ga	Jeffery.
School children	1, 440	68	4. 7	1955	Cumberland County, Tenn.	Young.
Total	6, 336	552	8. 7			
Institution						
Mental hospital	1, 408	58	4. 1	1954	Milledgeville, Ga	Jeffery.
Grand total	12, 716	1, 341	10. 5			

Table 8. Summary of surveys for Entamoeba histolytica in various population groups in certain southeastern States prior to 1945 and for 1945–54

Nature of group	Prior to 1945			1945–54		
	Number examined	Number positive	Percent positive	Number examined	Number positive	Percent positive
Inpatients and outpatients	8,874	713	8.0	4,972	731	14.7
General population (nonpatient status)	31,279	3,729	11.9	6,336	552	8.7
Institutionalized individuals	2,574	234	9.1	1,408	58	4.1
Total	42,727	4,676	10.9	12,716	1,341	10.5

parasite incidence over the 21 years. The difference in prevalence appeared to be due primarily to a lower current incidence in the adult population. No special efforts were made during the period represented to reduce the parasite burden of the community, and improvements must be regarded as accruing from economic and general sanitation advances.

Trichinosis

A number of surveys involving the examination of the diaphragm for *T. spiralis* among persons coming to necropsy in the southeastern States have been conducted by various individuals. The total number of diaphragms examined were 2,233, of which 323, or 14.5 percent, were positive for the parasite (table 10). This incidence figure is only slightly lower than that encountered by Wright, Kerr, and Jacobs (*20*) in 1943 in the examination of 5,313 diaphragms from 37 States and the District of Columbia, of which 855, or 16.1 percent, were positive.

Table 9. Results of parasite surveys in a western Tennessee community 1930 and 1951

Parasite	1930 survey;[1] percent positive of 357 examined	1951 survey;[2] percent positive of 322 examined
Ascaris lumbricoides	32.8	9.6
Trichuris trichiura	10.6	0.9
Necator americanus	5.9	1.9
Entamoeba histolytica	38.1	22.4

[1] Reference 19. [2] Reference 18.

The number of reported clinical cases of trichinosis in the region is not impressive, as indicated in table 11, and is certainly not correlated with the infection rate as revealed by the diaphragm surveys. In fact, the southeastern States rank well below many other parts of the United States in the number of reported clinical cases of the disease. This may be due to failure of diagnosis or failure to report some cases but is probably more closely related to food habits and a lower incidence of the parasite in southern swine (*21*). At any rate, if we are to judge correctly from the available data, trichinosis would not seem to constitute an important health problem in the southeastern States.

Toxoplasmosis

Toxoplasmosis is still an obscure disease, and little is known concerning its prevalence or mode of transmission. Clinical cases have occurred in the southeastern States, but since the disease is not a notifiable one, there is no record concerning the number of such cases. The only available data which throw light on the occurrence of infection in this part of the country are those derived from the application of the Sabin-Feldman dye test. Feldman (*22*) tested 270 individuals from New Orleans, La., of whom 84, or 31.1 percent, showed a positive reaction in a titer of 1:16 or greater. Gibson and associates conducted dye tests on 987 individuals from the rural Negro population of Fayette County, Tenn., of whom, he wrote in a personal communication, 27.5 percent were positive. Exclusion of positive serums with titers of 1:4 or

Table 10. Incidence of Trichinella spiralis infections in the population of 10 southeastern States as indicated by findings on diaphragm examinations

State	Number diaphragms examined	Number positive	Percent positive
Alabama	434	148	34. 1
Florida	15	2	----
Georgia	33	2	----
Kentucky	570	89	15. 6
Louisiana	600	31	5. 2
Mississippi	60	4	6. 7
North Carolina	123	6	4. 9
South Carolina	15	1	----
Tennessee	250	29	11. 6
Virginia	133	11	8. 3
Total	2, 233	323	14. 5

below reduced the overall incidence by about 8 percent. In a personal communication, Jacobs wrote that he conducted tests on 207 individuals from Norfolk, Va., and found 42 percent positive with a titer of 1 : 16 or more.

If dye test results are indicative of past or present infection with *Toxoplasma gondii*, and the tests are believed to have considerable validity in this respect, the limited data would indicate that toxoplasmic infection is far from uncommon in the southeast. In addition to congenital toxoplasmosis and acquired postnatal disseminated clinical infections, the role of the organism in the production of chorioretinitis and uveitis (*23*) indicates that toxoplasmosis may well prove to be a disease of considerable public health importance.

Table 11. Clinical cases of trichinosis reported from 10 southeastern States in various years

State	Total cases to Jan. 1, 1949	1949	1950	1951	1952	1953	Total
Alabama [1]	2	0	0	0	0	0	2
Florida	46	0	0	1	0	0	47
Georgia	45	0	0	0	4	0	49
Kentucky	10	0	0	0	0	0	10
Louisiana [1]	19	0	0	1	2	1	23
Mississippi	20	0	0	0	0	0	20
North Carolina	4	0	0	0	1	2	7
South Carolina	5	0	0	0	0	4	9
Tennessee	31	0	1	1	2	2	37
Virginia [1]	30	0	0	0	1	0	31
Total	212	0	1	3	10	9	235

[1] Not notifiable.

Table 12. Malaria morbidity reported and cases appraised in the United States, 1948–53

Year	Reported morbidity [1]		Cases appraised [2]			
	Number cases	Rate per 100,000	Number	Confirmed [3]	Confirmed primary indigenous	Presumptive primary [4] indigenous
1948	9, 797	6. 7	770	242	----	----
1949	4, 231	2. 8	514	60	17	46
1950	2, 227	1. 5	713	30	6	39
1951	5, 600	3. 7	[5] 1, 874	1, 272	14	5
1952	7, 023	4. 5	[5] 3, 098	2, 707	34	16
1953	1, 310	0. 8	[5] 449	217	30	3
1954	[6] 706	----	124	95	8	1

[1] National Office of Vital Statistics, Public Health Service. [2] Appraised by the Communicable Disease Center, State, or local epidemiologists. Positives all confirmed by blood smear for 1948. [3] Clinically and epidemiologically consistent with malaria, confirmed by positive blood smear. [4] Clinically and epidemiologically consistent with malaria, not confirmed by positive blood smear. [5] Case records on file at the Communicable Disease Center. Many cases of foreign origin investigated by State epidemiologists are not included. [6] Provisional data through Dec. 18, 1954.

Malaria

The rapid decline and the virtual extinction of malaria in the United States should stand as a fitting monument for all time to those who participated in the campaign, and to all who were engaged in the research and development which contributed to its success.

Great strides were made toward control of the disease during the war years through the Office of Malaria Control in War Areas. The national malaria eradication program was activated on July 1, 1947 (*24*) as a cooperative effort on the part of the States and the Public Health Service. As the campaign gained momentum substantial reductions were made in the number of reported cases, a trend which was interrupted only during 1951 and 1952 following the return from Korea of military personnel infected with *Plasmodium vivax* (table 12). When this threat was removed, the number of cases continued to drop, so that by 1954 there were only 8 confirmed primary indigenous cases and 1 presumptive primary indigenous case in the entire country.

The southeastern States, formerly the hotbed of malaria, are now practically free of the disease. Thus there has been conquered, probably for all time, the most serious of the parasitic diseases which have plagued this part of the country since the earliest of colonial days.

Conclusions

The data presented certainly warrant the general conclusion that remarkable declines have been registered in the incidence and intensity of certain parasitic infections in the southeastern United States. In most areas, intestinal helminths are much less prevalent than they were two decades ago. On the other hand, there appears to have been no marked reduction in the incidence of *Entamoeba histolytica*, although the number of reported cases of amebiasis seems to be on the decline. Trichinosis does not appear to be important in this area. The virtual eradication of malaria has eliminated one of the most serious health problems of the southeast. Zoonotic larval ascariasis and creeping eruption, conditions which are due to larval forms of certain dog and cat parasites, are still prevalent in the area; the former will probably be recognized with increasing frequency. Nematode endophthalmitis and toxoplasmosis are known to occur and may also prove to be of increasing importance.

While improvements are obvious, the situation does not warrant complacency. Health is a relative state. A heavy parasite burden is no doubt deleterious, but we cannot be equally certain that a few parasites are entirely innocuous. There are probably many implications of parasitism of which we are not aware. There is increasing evidence, for instance, that certain parasites may be the means of transporting other disease agents. The classic discovery of Shope (*25*) that the swine lung worms, *Metastrongylus apri* and *Metastrongylus pudendotectus*, carry the virus of swine influenza; the findings of Syverton, McCoy, and Koomen (*26*) that the larvae of *Trichinella spiralis* are capable of transporting the virus of lymphocytic choriomeningitis; and the recent disclosure by Mochizuki, Tomimura, and Oka (*27*) that *Toxocara canis* larvae can open the blood-brain barrier and pave the way for the localization of the virus of Japanese B encephalitis should make us hesitate to deprecate too quickly the health hazards of even a modest parasitic invasion of the human body. As Hardy (*28*) has so aptly stated, "Optimum health, not the mere absence of obvious illness, is the objective of public health and obstacles to the attainment of this goal must be removed. The individual has a right to be free of parasites. . . ."

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PHR

Veterinary Parasite Problems

By W. S. BAILEY, D.V.M., Sc.D.

PARASITISM has exerted a tremendous influence on the livestock industry of the southeastern United States. The story of cattle tick fever and its eradication is a familiar one. Other parasitic infections of a less spectacular nature have continued to plague our livestock, usually in the form of inapparent or undiagnosed chronic infections. Such infections tend to attract little attention until an acute clinical outbreak occurs. Certainly parasitism in the domestic animals is not a problem peculiar to the southeastern States, but a number of factors (*1*) contribute to make many of our problems of greater magnitude than in other areas of the United States.

The very large number of parasites of domestic animals in the southeastern States vary greatly in their distribution, incidence, and pathogenicity. It is difficult to present an accurate, brief account of the veterinary parasite problems. This is particularly true since our knowledge of these parasites is, in many instances, incomplete or entirely lacking. The task is seen to be more difficult when one realizes that the line of demarcation between clinical and subclinical, or latent, parasitism is variable, influenced by a number of factors in the host-parasite relationships. Consequently, many parasites not generally considered to be primarily pathogenic may be of importance in a particular disease of an individual or group of animals.

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Specific parasite problems will be discussed by the host relationship. No attempt will be made to rank the infections according to importance or to catalog all of the parasites that may be present as major factors. Rather, a brief summary of internal parasitism in the different animals will be presented, and one or more entities will be discussed in greater detail because of differences in incidence, greater economic importance, or biological interest.

Cattle

During the past 10 years there has undoubtedly been a greater change in parasitism of cattle in the southeast than in any other host and probably than in any other area. The most striking aspect of this change has been the common occurrence of clinical parasitism in mature animals. The figures below illustrate the marked increase in clinical parasitism in southern Georgia as determined at autopsy by Andrews, Sippel, and Jones at the Tifton, Ga., experiment station (*2*).

Year	*Percent of cattle with clinical parasitism*
1945–50	Negligible
1950–51	6
1951–52	11
1952–53	17

From March 21, 1952, to June 2, 1953, 14 animals, aged from 6 months to 10 years, were found to have been suffering from clinical parasitism at autopsy. The animals were from 10 farms on which there was a death loss of 5 percent of 1,900 animals.

Although the criteria are not exactly the

same, and, no doubt, evaluators differ somewhat, these figures appear to be rather close to those given in the following table taken from the autopsy records of the department of pathology and parasitology, School of Veterinary Medicine, Alabama Polytechnic Institute. The diagnosis for 11.1 percent of 422 cattle autopsied was primary parasitism, and the diagnosis for an additional 5.6 percent of these cattle was secondary parasitism.

The results of Cooperrider's study (*3*) on the economic losses in cattle due to internal parasitism further emphasize the common occurrence and great importance of clinical parasitism of cattle in this area. We would be amazed if we could but know the magnitude of the loss resulting from combined clinical and subclinical parasitism of cattle in the southeast.

These losses are due primarily to infections with the stomach worms, *Haemonchus*, *Ostertagia*, and *Trichostrongylus*. These natural infections are almost always in the form of a parasitic gastroenteritis, with certain intestinal parasites contributing to the disease. In some instances the intestinal parasites are the primary cause of the syndrome.

There is relatively little information on the number of these parasites required to produce clinical parasitism and death. This is mainly because parasitic infections may be parts of more complex diseases in which malnutrition and concurrent or previous infections with other pathogens play major roles. Rarely will one find infections with more than 10,000 *Haemonchus*, but as many as 300,000 immature *Haemonchus* have been reported. The presence of 50,000 to 75,000 *Ostertagia* or *Trichostrongylus*, or both, is apparently sufficient to cause severe symptoms and death in some animals. Recent reports include a number of cases with from 200,000 to 500,000 of these worms, and as many as 1,100,000 have been found. In these massive infections a large percentage of the worms often are immature.

Primary and secondary parasitism as found at autopsy at the Alabama Polytechnic Institute, May 1, 1953, to Mar. 18, 1955.

Host	Number animals autopsied (all ages)	Primary parasitism [1]		Secondary parasitism [2]	
		Number	Percent	Number	Percent
Dog	532	38	7.2	23	4.3
Cat	51	3	6.8	2	3.9
Sheep and goat	52	8	15.3	1	1.9
Cattle	422	47	11.1	24	5.6
Equine	46	3	6.5	2	4.3
Hog	186	5	2.6	7	3.7

[1] Considered the primary cause of death. [2] Considered to be a contributing factor to the illness and death of the animal.

All three of the stomach worms are bloodsuckers and anemia of variable degree is a characteristic symptom of *Haemonchus* and *Ostertagia* infections. Digestive disturbances, usually in the form of a persistent diarrhea, are almost constantly present. There is a great need for additional information on the host-parasite relationships of these worms, especially with regard to pathogenesis and immunity.

The intestinal helminths contributing most to general parasitic gastroenteritis and which may be primarily responsible for the disease under certain conditions are: *Cooperia* spp.; *Bunostomum phlebotomum*, the cattle hookworm; *Nematodirus* spp.; and *Oesophagostomum radiatum*, the nodular worm.

There are a number of other helminths in the intestines of cattle, but they generally are of little pathogenic importance in the southeast. One or two of these should be mentioned, however. *Neoascaris*, the cattle ascarid, may be a problem in individual herds. It apparently is found more in scattered herds in Louisiana and Florida than in any other of the southeastern States. The anoplocephaline tapeworms, *Moniezia* spp., are quite common but appear to be relatively nonpathogenic. There is, however, the tendency to attribute damage produced by the minute parasites to these large ones.

Coccidiosis continues to be an important problem in many herds. Of the 10 species occurring in cattle in this area, *Eimeria zurnii* and *Eimeria bovis* are the most pathogenic, but some of the others may contribute to, or be primarily responsible for, the infection. As is true with the worm infections, older animals may also have clinical coccidiosis.

Fasciola hepatica infections have been diagnosed in a number of the southeastern States.

At the present time the only State east of the Mississippi River in which *Fasciola* infection is considered to be of any appreciable importance is Florida. *Fascioloides* infection is probably much more widespread than reports indicate. Although many deer in certain areas of Alabama are infected, the first bovine case came to our attention last year. It is not known if the case was an autochthonous infection.

Lungworm infection is quite widespread in the southeast, and is especially important in the low, wet areas which provide an ideal environment for the larvae. Heavy infections often result in severe bronchitis and death. We do not appear to have in the area the "atypical" lungworm infection of mature cattle described recently by the English workers (*4*), but the possibility of this should not be overlooked, especially in the wet areas.

Bovine genital trichomoniasis, caused by *Trichomonas foetus*, has been diagnosed in practically all the States. This disease does not appear to have caused as much trouble in most southeastern States as it has in the more heavily concentrated dairy areas of the midwest. In individual herds in any of the States, however, it may be of great economic importance. Until 1954 we knew of no definite diagnosis of this infection in Alabama. Our first diagnosis was made in a herd into which bred heifers were brought from a midwestern State. Since that time the infection has been diagnosed in three additional herds and probably exists in a number of others.

Although the exact classification of the etiologic agent of anaplasmosis is unsettled, it is included with the parasitic diseases in this discussion. In some of the southeastern States anaplasmosis is currently of only spotty distribution and little importance. However, South Carolina, Florida, Mississippi, and Louisiana may truly be referred to as enzootic areas. The incidence and distribution of this disease is intimately related to, but not limited by, the density of the several arthropod vectors which may transmit it.

Sheep and Goats

The prevalence of internal parasites was a major factor in the decline of the sheep industry in a number of southeastern States in years past, and the promise of better control measures has contributed to an increase in the sheep population in recent years. Since many of the problems are much the same as for cattle and are produced by the same or closely related species of parasites, no separate discussion for these hosts will be given in this general and brief review.

Swine

A number of the gastrointestinal parasites of hogs are not appreciably different in the southeastern States from most of the rest of the country, although the intensity of infection may be somewhat heavier. The stomach worms are widely distributed, but are not often primarily responsible for trouble. The hog ascarid is also widely distributed and of major importance. Undoubtedly many of the factors relating to the distribution and epidemiology of the human ascarid are also operative in this infection.

The thorny head worm of hogs is not as widely distributed as the ascarid but may be an important problem in given herds, in which control is difficult. Occasionally, death occurs from light infections due to peritonitis resulting from perforation of the intestinal wall by the proboscis. Of the several species of nodular worms infecting the hog, only one, *Oesophagostomum dentatum*, appears to be widely distributed in this country. The others are somewhat restricted to the southeastern States. Lungworm infection is quite common and is often the cause of respiratory symptoms and even death.

The kidney worm of hogs, *Stephanurus dentatus*, is of little importance outside the southeast. In fact it is only in the lower tier of States and up the Atlantic seaboard to Virginia that the infection is of any great significance. In these areas, however, it is still a major problem, and losses occur in a number of ways. The loss most easily determined is that due to condemnation or trimming of parts of carcasses at the killing abattoir.

According to a personal communication from J. A. Langford a heavy infection with the larval stage of *Diphyllobothrium* (*Spirometra*)

mansonoides was diagnosed in a range hog in Florida recently.

Poultry

Little will be said about poultry parasites. The common gastrointestinal helminths and protozoa are widely distributed and of variable importance throughout the southeast.

Leucocytozoon smithi infection of turkeys appears to be quite common in many parts of the southeast, as evidenced by the observations of a number of workers (*5–8*). Bierer (*8*) indicates that this is primarily a disease of the tidewater area along the eastern seaboard. Recent outbreaks in South Carolina have been particularly striking. Wild turkeys apparently served as a reservoir of infection. The disease may be very acute and highly fatal as described by Stoddard and associates (*7*), who reported 75 percent mortality of 1,600 birds in 7 days, or it may be more insidious and with low mortality. The latter outbreaks may be associated with the breeding season in which case there seems to be a greater mortality in toms than in hens.

Equines

With the decrease in the horse and mule population, a number of the parasite problems in these animals have become less marked but have by no means disappeared. Bot infections are still very common, and marked gastritis due to infections with *Trichostrongylus axei* is quite common. The latter is not surprising in view of the increasing importance of this parasite in ruminants, inasmuch as there is good evidence that cross transmission occurs. Cutaneous habronemiasis is seen much less than in earlier years. However, this disease may constitute a problem on even the best of farms if the animals are infected with the adult worms and there is a high transmission potential because of an abundant fly population.

The most important intestinal parasites are the ascarid, *Parascaris equorum*, and the strongyles, particularly the large strongyles, *Strongylus vulgaris*, *Strongylus edentatus*, and *Strongylus equinus*. Ascarid infections are usually of clinical significance only in young animals. In addition to the bloodsucking activity of the large strongyles, the parasitic aneurysm produced by *S. vulgaris* is of great importance. This aneurysm, with the resulting thrombus formation, of the anterior mesenteric artery may cause a variety of intestinal disturbances, and frequently results in death. Pinworm infection may constitute a problem in individual or groups of animals, but it generally is of little pathogenic importance.

Dogs and Cats

Spirocerca lupi, the dog esophageal worm, appears to be very rare in this country except in the south. Over a period of approximately 4 years we have found slightly over 4 percent of 943 dogs of all ages infected (*9*). Since this includes a large number of puppies, the incidence in dogs old enough for the life cycle to have been completed would be appreciably higher. Only a small percentage of the dogs infected with *Spirocerca* show clinical symptoms. However, this infection takes on added interest and importance in view of the recent report by Seibold and associates (*10*) that it may be an inciting cause of the development of malignant esophageal tumors of the dog.

A number of intestinal helminths are very widely distributed, not only in the southeast but in much of the Nation, and some are highly pathogenic. We have no comprehensive figures on the incidence of *Strongyloides* in the dog in the southeast, but it is certainly more common than the reports indicate. It is often the cause of respiratory symptoms and intestinal disturbance, and the mortality rate in heavily infected puppies is quite high. Although the worm is apparently indistinguishable from *Strongyloides* of man, it is likely that man does not easily become infected with the dog form.

The hookworms, *Ancylostoma caninum* and *Ancylostoma braziliense*, continue to take a heavy toll of our young dogs. Prenatal infections are very common and highly pathogenic. Some of the heaviest infections have been in mature dogs concurrently suffering with some other disease.

Roundworm infections are very common, especially in young dogs, with prenatal infection

again being of great importance. *Toxocara canis* is the one most often encountered.

Light tapeworm infections are found in a high percentage of dogs, and heavy infections are common. *Dipylidium caninum* is the one found most often in this area, but *Taenia taeniaformis* and *Taenia pisiformis* are not uncommon and seem to occur most often in the cat. There is a recent report of natural infection of dogs with *Echinococcus granulosus* in Mississippi (*11*). The public health importance of this needs no elaboration.

Pseudophyllidean tapeworms appear to be rare in dogs in this area. *Diphyllobothrium latum* has been reported from Florida. *D. (Spirometra) mansonoides* has been reported from Louisiana and, during the past year, from the Alabama-Georgia area (*12*). Langford, who recently sent us the larvae of this parasite from a hog, in his letter reported finding a number of cases of *Diphyllobothrium* infection in dogs and cats.

Light to moderate infections with the whipworm, *Trichuris vulpis*, are common in the dog, and occasionally very heavy infections are encountered in which the parasite is apparently the cause of death. In such cases not only is the cecum filled with worms, but the entire surface of the colon is covered.

A number of intestinal protozoa are commonly found in the dog. Eyles and associates (*13*) have recently reported finding 8.4 percent of 143 dogs in Memphis, Tenn., infected with *Entamoeba histolytica*, using cultural methods. We certainly agree with their observation that cysts of *E. histolytica* are almost never passed and that the trophozoites are passed in small numbers in the feces of dogs.

Shown below are the protozoan infections found by direct smear examinations at the small animal clinic, Alabama Polytechnic Institute, from September 1953 to May 1954. Of 871 dogs examined, 193, or 22 percent, were found to have protozoan infections, although there may have been more than one infection per dog.

	Number	*Percent*
Giardia	75	8.6
Trichomonas	57	6.5
Isospora	44	5.0
Entamoeba histolytica	7	.8
Entamoeba coli	1	.1
Balantidium	9	1.0

Each of the seven dogs infected with *E. histolytica* showed a characteristic profuse diarrhea, continuous or intermittent and often of long duration. In the *E. coli* infection, cysts were being passed, and this dog was concurrently infected with *E. histolytica*. Only a small percentage of the dogs infected with *Giardia* showed symptoms attributable to the organism. It is possible even in these cases that the symptoms are not due solely to the protozoan. There is evidence (*14*) suggesting that a combined *Giardia* (protozoa) and *Pseudomonas* (bacteria) infection may be quite pathogenic in the chinchilla. The intestinal trichomonads are common in the dog, and the incidence figure rises rather markedly when cultural methods are used in diagnosis. Here again the organism appears to be associated occasionally, apparently in some causal relationship, with a severe diarrhea, which may also be of long duration.

Even though occurring in a low percentage of dogs, *Balantidium* infection is much more common than we had earlier suspected. It appears to be pathogenic in the dog in practically every infection. Light infections with the dog coccidia are common, and when animals, especially puppies, acquire heavy infections, marked symptoms and death may result. In Georgia, 2 of 3 recently reported cases of human infection with *Isospora* appeared to be related to an infection in the family dog (*15*).

Although we probably have more information on the distribution of *Dirofilaria immitis*, the dog heartworm, than on almost any other of the parasites of veterinary importance in the southeast, its distribution still has not been well defined. The infection is obviously quite common in many areas where it is not present at disease-producing levels. The presence of adult worms in sufficient numbers to result in clinical infection is evidence of a high transmission potential. On the basis of current information this appears to be common in the southeast only along the seacoast. There are inland areas where the transmission potential is sufficiently high to result in the presence of moderate numbers of adults and even in some instances in clinical infection, as emphasized by Eyles and associates (*16*) in their recent study in the area of Memphis, Tenn. Auburn, Ala., is a good

example of an area with low transmission potential. In a recent limited survey it was found that microfilariae could be demonstrated, using concentration procedures, in approximately 37 percent of the dogs. Our autopsy records of the past 5 years have not been summarized to give the incidence of adult worms, but it certainly is appreciably lower than the 4 percent found in Memphis. The only clinical cases which have come to autopsy in recent years were sent to us from coastal areas where the infection is certainly a major problem.

There are a few reported cases of the giant kidney worm, *Dioctophyma renale*, in the southeastern States (*17*). There appears to be a small enzootic area in southeast Georgia.

We do not know how common canine toxoplasmosis is in the southeast. Serologic tests made elsewhere indicate that inapparent or otherwise undiagnosed cases are quite common, as in other animals. From July 1954 through March 1955 we autopsied 148 dogs, of which 6, 4 percent, were diagnosed as toxoplasmosis, or toxoplasmosis together with distemper. In addition to these cases from autopsy, all of which were from Alabama, we have made a diagnosis during this period of toxoplasmosis from at least one place in Florida, Georgia, South Carolina, Virginia, and Tennessee by the histological examination of tissues sent to us by practicing veterinarians.

The cat lungworm *Aeleurostrongylus abstrusus*, has been reported from Maryland, Virginia, North and South Carolina, Georgia, Tennessee, and Alabama (*18*). In these States although there are few reports of the infection, mostly only 1 or 2, many of these are fatal infections. Probably the infection is much more common than published reports indicate, as suggested by the recent finding of the infection in 6 of 50 cats in a Virginia county.

Information Needed

There are many different aspects of these and other infections that could profitably be discussed. This very incomplete account will be closed by pointing out the general needs with regard to veterinary parasitology in the southeast.

1. More information on the distribution and incidence of parasitic infections to determine more clearly the true nature and extent of the problem.

2. Better use of the information currently available in the control of these parasites.

3. More information on the biology and host-parasite relationships of the many parasites common in the southeast, for only on this foundation can we build truly effective control programs.

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Silicosis and Dust Control

—Vermont's Granite Industry—

By HARRY B. ASHE, B.S.

VERMONT granite is a heterogeneous mixture of approximately 60 percent feldspar, 30 percent quartz, 15 percent mica, and 5 percent miscellaneous silicates. Quartz is, of course, the black sheep of the group of minerals which comprise this monumental stone.

Pneumatic tools came into general use between 1895 and 1900, accompanied by a tremendous increase in dust production over that produced by hand tools. Industrywide dust control for all dust-producing operations had its beginning in 1937. Hence, the period of greatest dust exposure in the Vermont granite manufacturing industry is about 40 years.

A Bench Mark

The year 1937 is a bench mark in the Vermont granite manufacturing industry. A program of dust control for all dust-producing operations was put into effect by the industry. A division of industrial hygiene was created in the Vermont Department of Health, and for many years it concentrated most of its efforts in improving working conditions in the industry. The division purchased a portable X-ray machine and began a yearly X-ray program, which is still in effect.

During the period 1924–26, dust exposures in this industry were reported by the Public Health Service to be about 1 to 200 million particles per cubic foot of air. Granite cutters who suffered the most severe exposure averaged an exposure of about 60 million particles per cubic foot of air (*1*). Since the beginning of plant-wide dust control in 1937, the dust exposure has been gradually reduced.

Recent dust counts in the industry indicate a general air dustiness of 1 to 2 million particles per cubic foot of air, with few individual operators exposed to greater than 5 million particles per cubic foot of air. Recirculation of dust collectors has been completely discontinued, and dry dust-producing operations in the industry are provided with an approved type dust collector. Every exhaust unit in the industry is inspected by the division of industrial hygiene at least twice a year, and detailed reports are sent to the individual manufacturer with a mandatory compliance order wherever corrections or improvements are necessary.

During 1937 and 1938 there was a very definite effort to encourage men to visit the division office for an X-ray at any time during their free hours. During that period, the division X-rayed 805 granite workers for the first time.

Mr. Ashe, director of the division of industrial hygiene, Vermont Department of Health, since 1946, served as program chairman of the American Conference of Governmental Industrial Hygienists, 1953–54, and as chairman, 1954–55. *This paper was presented at the 17th annual meeting of the conference in Buffalo, 1955.*

Table 1. Number of granite workers X-rayed, Vermont Department of Health, 1937–54

Year	Number X-rayed		
	First time	Re-checks	Total
1937	645	0	645
1938	160	211	371
1939	89	169	258
1940	90	155	245
1941	137	308	445
1942	83	251	334
1943	86	212	298
1944	38	183	221
1945	37	248	285
1946	109	235	344
1947	62	325	387
1948	203	452	655
1949	36	320	356
1950	239	698	937
1951	475	519	994
1952	209	1, 178	1, 387
1953	191	1, 262	1, 453
1954	131	1, 306	1, 437
Total	3, 020	8, 032	11, 052

From 1938 to 1950, evening clinics were held for granite workers in the division office. Results are shown in table 1. However, many men were not availing themselves of this service provided by the State of Vermont, and in 1950 arrangements were made with the various manufacturers to set up our portable X-ray machine in their establishments so that men could be X-rayed on company time. By this change of procedure, 937 and 994 men were X-rayed in 1950 and 1951, respectively.

Mobile X-ray Unit

During the summer of 1951 we conceived the idea of constructing a mobile X-ray unit whereby our X-ray machine could be transported to every shed in the area and our service offered to the men at a distinct saving to the manufacturer. This unit was put into service in the fall of 1951 with an increase in participation of about 400 men a year.

The 26-foot trailer consists of a small room in the rear for occupational histories, a darkroom for changing films, an X-ray compartment in the middle, and a dressing room in the front. A 3,000-watt, 220, 110-volt generator supplies the power, and a State-owned automobile provides the transportation. Lead-lined plywood is used in the interior construction to protect operating personnel from stray radiation.

This mobile X-ray unit, designed to X-ray men in dusty trades at their place of employment, was put into operation in September 1951. It has traveled 8,000 miles and taken 13,776 X-rays. The industries covered are granite, marble, slate (quarrying and finishing); asbestos (quarrying and milling); talc (mining and milling); copper (mining and processing); foundries (gray iron). The cost of the unit follows:

26-ft. Travelo trailer, custom built, with furnishings	$3, 072
Picker portable X-ray machine, 15 ma., 8-step voltage control, 14" by 17" plates	1, 350
Pass box, casette holder, casettes, and other accessories	805
3,000-watt Onan electric plant, installed	910
State-owned automobile, overload springs, trailer hitch, accessories	2, 727
Total cost	$8, 864

1937–1938

Approximately 2,400 men were employed in the Vermont Barre Belt granite manufacturing district in each of the years 1937 and 1938. Of the 805 men X-rayed, 365 had silicosis (45.3 percent); and 143 had silicosis with possible infection (17.9 percent).

All cases with definite X-ray evidence of nodular silicosis, whether it be early, moderately advanced, far advanced, or complicated with infection, are grouped together. In the category "silicosis plus possible infection," the infection is presumed to be tuberculosis. However, in these data (table 2) there has been no attempt to prove the existence of infection. It is very probable that a number of the men listed in this category have nothing more than a conglomerate silicosis. Some of them may have cavitation and positive sputa. For the purpose of this paper they are likewise grouped together.

1952–1954

The 3 years from 1952–54 have been taken for comparison with 1937–38 inasmuch as the

Table 2. Number of granite workers X-rayed and found to have silicosis, Vermont Department of Health, 1952–54

Number of men	1952		1953		1954	
	Number	Percent	Number	Percent	Number	Percent
On payroll	1,736		1,810		1,809	
Working, day of X-ray	1,616		1,786		1,691	
X-rayed	1,387	85.8	1,453	81.4	1,437	84.9
On payroll, previously X-rayed but not in indicated year	185		232		261	
On payroll, X-rayed at least once	1,572	90.6	1,685	93.2	1,698	93.9
Found with silicosis	274		253		219	
On payroll, diagnosis silicosis, X-rayed at least once, but not in indicated year	45		69		75	
On payroll, diagnosis silicosis	319	18.4	322	17.9	294	16.2
Found with silicosis plus possible infection	54		44		28	
On payroll, diagnosis silicosis plus possible infection, X-rayed at least once, but not in indicated year	4		18		14	
On payroll, diagnosis silicosis plus possible infection	58	3.3	62	3.4	42	2.3

mobile X-ray unit was in operation during these years, and the greatest cooperation was received from both employer and employee. The data in table 2 indicate the proportion of persons in the Vermont granite manufacturing industry who were X-rayed during these years and found to have silicosis.

The gradual decrease in the incidence of silicosis from a high of 45.3 percent in 1937 and 1938 to a low of 16.2 percent in 1954 may be attributed to two causes: dust control and silicotics leaving the industry for one reason or another. The incidence of silicosis with possible infection has been reduced from 17.9 percent to 2.3 percent over the same period.

The X-ray program began in 1937. Consequently, there could be no backlog of X-ray data then. Hence, the data for the years 1937 and 1938 cannot be compared on the same basis with data for the years 1952–54. However, we believe, the data presented here demonstrate an apparent striking decrease in the incidence of this occupational disease in a very hazardous industry. The majority of the 2,400 men employed in the industry in 1937 probably had more than 10 years experience; only 34 percent of these were X-rayed, and 45 percent of those X-rayed were found to have silicosis. It is generally believed that if it had been possible to examine the chest X-rays of every man employed in the industry at that time the incidence of silicosis might even have been higher. In 1954, for contrast, of all the men on the payroll, 18.4 percent were found to have silicosis (or 19.8 percent of those who had X-rays). Participating in the program, however, were 90.6 percent of the employees.

Summary

Our X-ray program started in 1937. Dust control started the same year and has gradually improved ever since. The State health department has not to this day discovered a case of silicosis in any man who has worked only in the Vermont granite manufacturing industry since 1937. It is our contention that this remarkable record is mainly due to effective dust control within the industry.

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Venereal Disease in Migrant Workers New Jersey, 1954

By ADELE C. SHEPARD, M.D., M.P.H., and WILLIAM J. PAGE, Jr., B.A.

ABOUT 18,000 migrant workers are required each year to supplement local labor in agriculture and in the food processing industries (*1*), the New Jersey Department of Labor and Industry estimates. This does not include the seasonal labor force necessary to meet the needs of resort areas, race tracks, and other industries which utilize migrant labor. In 1954, approximately 9,000 persons from Puerto Rico, 6,000 southern Negroes, and 3,000 workers of various types from neighboring cities came into New Jersey as migrant workers.

Examination of 3,401 migrant agricultural workers in New Jersey in 1953 showed a very high incidence and prevalence of venereal disease (*2*). The serologic survey of this group was continued in 1954 and, in addition, a survey was made of migrant race track workers and itinerant workers in the seafood industries. This report presents the results of the latter survey.

Generally speaking, migrant workers do not receive regular medical services (*3*). At best, the rural areas where they find employment usually have inadequate public health facilities so that the extension of existing services to include migrant workers is minimal. Furthermore, the training of migrants is such that they often do not take advantage of even such assistance as is made available to them. The special migrant health program provided in New Jersey, therefore, is a product of necessity (*4*). The program is largely one of venereal disease control, although some attention is given to other health problems.

The first large groups of agricultural workers begin to arrive in New Jersey in May, although the majority do not appear until July. Permanent clinics have been established in three areas of heavy concentration of migrants, and a mobile unit operated for about 6 weeks during the peak season reaches more than half the persons tested each year. The remaining workers are tested at the permanent clinics. The staff of each clinic consists of professional, technical, and clerical personnel. During the period July 15–September 15, two additional persons are usually employed to contact farmers, contractors, and workers in order to promote clinic attendance. Although there is a legal requirement that workers obtain physical examinations, few of them actually apply for medical service until they are motivated by a personal visit from a member of a clinic staff.

In 1954, a total of 3,288 farm migrants were examined for venereal disease during clinic sessions. All persons over 12 years of age were tested serologically for syphilis and an inspection of mouth and genitalia was ordered on all

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males. All females with positive serologic tests for syphilis (STS), all contacts of both sexes to cases of venereal disease, and all individuals complaining of or manifesting obvious signs or symptoms of disease had a more complete examination. A presumptive diagnosis of venereal disease was permitted on the basis of objective clinical findings or one positive or doubtful result of the STS. No spinal fluid examinations were done. Routine treatment for syphilis was 4,800,000 units of procaine penicillin in oil with 2 percent aluminum monostearate (PAM) given in four sites in the buttocks during a single clinic visit; for gonorrhea, the treatment was 600,000 units of PAM.

Discovery Rate Decreasing

When summary data for 1954 are compared with summary data for 1953, there appears to be a decreasing discovery rate of venereal disease among agricultural migrants. Of the 3,288 farm migrants examined in 1954, 22.8 percent were reactive for syphilis (table 1). The proportion was 25.2 in 1953.

The number of diagnoses of infectious venereal disease also showed a decrease last year over the year before. A total of 198 patients with clinical gonorrhea was treated in 1953 and only 118 in 1954 (table 2). Similarly, 19 cases of primary and secondary syphilis were found during 1953, whereas only 9 such cases were seen last year.

The number of persons brought or returned to treatment for syphilis dropped from 406 in 1953 to 232 in 1954. Several factors might account for this decrease. Although in 1954, followup of persons with positive and doubtful blood tests was better than average for survey work—85.1 percent of the 758 suspects were brought to examination—the proportion was less than the 95.6 percent brought to examination in 1953 (table 3). In addition, many individuals were not treated because they were judged either to have had adequate treatment previously or not to be infected with syphilis. Records of previous blood tests and previous therapy for many individuals who return to New Jersey year after year are now accumulating to assist physicians in ruling out the need for treatment. Also, when patients with positive STS results give a fairly reliable history of previous treatment elsewhere, they are not required to return for re-treatment.

Epidemiological Study

With existing facilities, there is apparently no easy solution to the problem of thorough contact interviewing and investigation in the migrant labor group. In the migrant health clinics, thorough epidemiological study was very difficult for several reasons:

1. Space was inadequate for proper contact interviewing.
2. Lack of privacy reduced the effectiveness of interviewing.
3. In crowded clinic situations, physicians often failed to refer patients for interview.
4. Interviewers were often pressed into serv-

Table 1. Results of serologic tests for syphilis in migrant agricultural workers, by age group and sex, New Jersey, 1954

Age group	Total tests			Number positive			Number doubtful			Percent positive and doubtful		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
All ages	3, 288	2, 220	1, 068	397	236	161	352	232	120	22. 8	21. 1	26. 3
Under 15	210	119	91	8	3	5	8	5	3	7. 6	6. 7	8. 8
15–24	1, 091	736	355	66	43	23	37	23	14	9. 4	9. 0	10. 4
25–34	878	613	265	103	51	52	109	66	43	24. 1	19. 1	35. 8
35–44	654	452	202	118	62	56	120	83	37	36. 4	32. 1	46. 0
45–54	313	203	110	63	46	17	55	40	15	37. 7	42. 4	29. 1
55–64	102	71	31	27	21	6	19	12	7	45. 1	46. 5	41. 9
65 and over	12	10	2	7	6	1	2	1	1	75. 0	70. 0	100. 0
Not stated	28	16	12	5	4	1	2	2	0	25. 0	37. 5	8. 3

ice as clerks or technicians in order to process large numbers of patients during short clinic sessions.

To the extent permitted within these limitations, patients with infectious venereal disease were interviewed and their contacts were investigated (table 4). In the interview, particular emphasis was placed on eliciting the names of those contacts who were known to be in the migrant labor force in New Jersey.

Race Track Workers

In addition to those employed in agriculture, there is another group of migrants, the race track workers, in which the State department of health has been interested for many years. The three large tracks devoted to horse racing operate for several weeks each year in an intermittent season running from May to October. Grooms, stable boys, exercise boys, jockeys, and concession employees follow the racing business in much the same manner as the migrant farm workers follow the harvest seasons. The Migrant Labor Law (*4*) makes it mandatory that these migrants be examined for venereal disease just as it requires that agricultural migrants be examined.

A total of 1,172 race track workers had sero-

Table 2. Cases of venereal disease among migrant agricultural workers diagnosed through serologic tests and physical examination by migrant health clinics, New Jersey, 1953 and 1954

Disposition of case	1953	1954				
	All clinics	All clinics	Orchard Center, Gelston Village	Freehold	Prospect Plains	Mobile unit
Total cases diagnosed	967	631	74	65	103	389
Brought to treatment	542	290	55	20	47	168
Syphilis	340	171	41	18	26	86
Primary and secondary	19	9	0	0	0	9
Early latent	135	90	29	6	5	50
Other	186	72	12	12	21	27
Gonorrhea	198	118	14	2	21	81
Other venereal disease	4	1	0	0	0	1
Returned to treatment for syphilis	66	61	9	6	15	31
Previously adequately treated for syphilis	359	280	10	39	41	190

Table 3. Results of investigation of migrant agricultural workers with positive or doubtful results of serologic tests for syphilis, New Jersey, 1953 and 1954

Disposition of case	1953	1954				
	All clinics	All clinics	Orchard Center, Gelston Village	Freehold	Prospect Plains	Mobile unit
Total investigated	799	[1] 758	95	75	132	456
Examined:						
Number	764	645	60	74	92	419
Percent	95.6	85.1	63.2	98.7	69.7	91.9
Not examined	35	113	35	1	40	37
Uncooperative	0	14	14	0	0	0
Moved out of jurisdiction	10	34	6	0	8	20
Cannot locate	20	58	12	1	30	15
No disposition after 30 days	5	7	3	0	2	2

[1] Includes 9 suspects (positive STS) referred to New Jersey by other States.

Table 4. Results of venereal disease contact interviewing and investigation of migrant agricultural workers, New Jersey, 1953 and 1954

Disposition of cases	Syphilis						Gonorrhea	
	Primary and secondary		Early latent		Other			
	1953	1954	1953	1954	1953	1954	1953	1954
Number patients interviewed	15	6	29	22	1	1	121	48
Number contacts obtained	48	12	99	36	1	3	153	62
Contact index	3. 20	2. 00	3. 41	1. 64	1. 00	3. 00	1. 26	1. 29
Number investigations assigned	7	4	6	2	1	1	128	27
Results of investigation:								
Number contacts examined	6	4	6	2	1	1	99	27
Number infected with disease of patient	2	3	3	2	1	1	43	17
Number treated [1]	2	1	0	0	0	0	49	10

[1] Prophylactic or epidemiological treatment.

Table 5. Venereal disease diagnosed through serologic tests and physical examination of 1,172 race track workers, New Jersey, 1954

Disposition of cases	Track			
	All tracks	Atlantic City	Garden State	Monmouth Park
Total reactive	180	76	70	34
Number diagnosed	130	73	33	24
Brought to treatment	53	39	6	8
Syphilis	37	24	5	8
Primary and secondary	2	0	2	0
Early latent	12	9	----	3
Other	23	15	3	5
Gonorrhea	16	15	1	0
Returned to treatment with syphilis	22	15	0	7
Previous treatment adequate	53	17	27	9
Infected, not treated	2	2	0	----
Not infected	19	8	8	3

logic tests for syphilis during 1954. Since many of the same workers were employed at each of the three race tracks during the course of the racing season, cards indicating that blood tests had been taken were given to them so that not more than one blood test would be required of each individual. Of the 1,172 workers tested, 180, or 15.4 percent, were reactive for syphilis (table 5). Of the reactors, 59, or 32.8 percent, were brought or returned to treatment. As in the agricultural migrant group, more than half of the suspects diagnosed as infected with venereal disease were declared previously adequately treated or as not infected with syphilis. Sixteen cases of gonorrhea were found and treated.

Itinerant Seafood Industry Workers

Besides agricultural and race track migrants, approximately 1,000 seasonal employees of seafood industries were tested during recent months. A group of plants in South Jersey employ a physician to examine and treat their employees for venereal disease. Complete data are not available at this time concerning the outcome on approximately 750 persons thus examined.

However, the State department of health arranged for the testing of 243 individuals who were directly or indirectly associated with the seafood industry; 77 reactors were found, or 1 of 3 tested. Of these, 35 patients were treated for syphilis, including 2 children with congenital syphilis. Again, about half of the reactors had received adequate treatment for their infections prior to this survey. In addition, 3 males with gonorrhea applied for and received treatment.

Other Migrant Workers

Many thousands of migrants other than the groups reported are tested each year in New Jersey. The State department of health has urged hotels, manufacturing industries, and others who employ migrants to perform the required health examinations. The result of this emphasis has been that a major share of the responsibility for examining migrant workers has been assumed by employers.

Summary and Conclusions

In summary, the total number of migrants examined by the State department of health last year was 4,703, of which 1,006, or 21.4 percent, were reactive for syphilis. Of these seropositive and doubtful, 513 presented evidence of previous adequate treatment or were judged not to be infected with syphilis. Of those remaining, 326, including 11 cases with lesions, were given treatment, and 167 were lost to followup. In other words, approximately 1 in 5 migrants examined had a positive or doubtful test for syphilis and 1 in 14 received treatment. In addition, 137 patients with gonorrhea and 1 patient with chancroid were treated.

Results obtained in the survey of migrant laborers indicate that a very high incidence and prevalence of venereal disease still exists in the three groups examined—migrant agricultural, race track, and seafood industry workers—and that there can be no doubt of the necessity for continuing survey and treatment operations.

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Sewage Treatment Plant Construction

Construction contracts for 169 projects to aid in stream pollution abatement were awarded by American cities in the first quarter of 1955. The contracts totaled $59 million and covered 72 new plants and 97 additions, enlargements, or improvements for existing plants which provide treatment of sewage from municipalities, institutions, and other significant population centers.

Chiropteran Rabies in Montana

By J. FREDERICK BELL, M.D., W. J. HADLOW, D.V.M., and WILLIAM L. JELLISON, Ph.D.

A BAT was brought to the Rocky Mountain Laboratory of the Public Health Service by one of its employees on August 20, 1954. The bat, found in a flowerbed at the employee's home, revealed its presence by squeaking at approaching children. Suspecting a snake, the children called their father, who captured the bat without difficulty since it made no attempt to fly.

Upon cursory examination in the laboratory, it was apparent that the animal was weak. Since the bat vociferated when the children approached, it was probably irritable. After euthanasia with ether, the brain was removed and a suspension of approximately 10-percent concentration in serum-saline was prepared from one-half of the brain. Four mice were inoculated intracerebrally with 0.03-ml. portions of the suspension, and the remainder was frozen in sealed ampules. The other half of the brain was fixed in Zenker's fluid. After necropsy, the thoracic and abdominal viscera as well as the carcass were placed in 10-percent formalin.

On the 16th day after injection of brain suspension, 2 of the mice were found dead. The brains were removed, pooled, triturated in serum-saline, and dilutions of the suspension were used to inoculate other mice. The earliest signs of illness in the mice of this second passage were seen on the 11th day, and 6 mice injected with the 10^1 dilution were dead by the 14th day. A similar incubation period was observed in third-passage mice injected intracerebrally. A fourth passage by the intracerebral route resulted in a shorter incubation period in those mice injected with 10-percent supernate, inasmuch as the first signs of illness appeared on the 7th day and all 6 mice were dead by the 11th day. Typical Negri bodies were found in the brains of the mice from the first and second passages.

Virus in the bat brain was not titrated immediately, but at a later date some of the original frozen suspension was found to contain $10^3LD_{50}/.03$ ml. The incubation period ranged from 14 to 19 days.

Dr. Bell is senior surgeon, Dr. Hadlow, a pathologist, and Dr. Jellison, a parasitologist, on the staff of the Rocky Mountain Laboratory, Public Health Service, Hamilton, Mont.

Microscopic Findings

Histological sections of the bat brain stained by Lillie's buffered azure eosinate method revealed widespread regressive changes in the neurons as evidenced by their shrunken, distorted, and hyperchromatic appearance. The neuronal damage was most conspicuous in the thalamus and hypothalamus and in some areas of the cerebral cortex but was evident also in the hippocampal formation and in the Purkinje cells of the cerebellum. Inflammatory changes were not observed with the exception of a scanty lymphocytic accumulation around several meningeal vessels. There was moderate hyperemia of the meningeal and parenchymal vessels.

Typical round and oval Negri bodies were found in the pyramidal cells of the hippocampus and the cerebral cortex (see fig.), in the Purkinje cells of the cerebellum, and occasionally in the nerve cells elsewhere in the brain. The inclusion bodies, however, were largest and most numerous in the hippocampus. The largest measured 3.5–4.0 microns in diameter and contained distinct basophilic granules, usually situated centrally in the inclusion and often surrounded by a prominent hypochromatic ring or halo. Individual neurons frequently contained several smaller, cytoplasmic inclusion bodies, measuring 1–2 microns. Some of these small inclusions appeared to be uniformly eosinophilic. The Negri bodies were found in apparently unaltered cells as well as in those showing marked regressive changes.

Microscopic sections of heart, lung, liver, spleen, kidney, and small intestine showed no noteworthy changes.

Large Negri body in a neuron of the hippocampus in the original bat brain, stained by azure eosinate (×2700).

Identification of the Virus

In view of present widespread reports of rabies in Chiroptera (*1*), rabies was suspected when the first-passage mice became ill. The appearance of the sick mice and the finding of typical Negri bodies in mice and in the bat brain were evidence that the disease was rabies or a hitherto unknown lyssoid infection. Therefore, neutralization and protection tests, with known rabies serum, and cross-protection tests, using vaccines prepared from fixed rabies and from the putative virus, were done.

Neutralization and Protection Tests

Antirabies serum was obtained from Dr. Karl Habel of the National Institutes of Health, Bethesda, Md. A serum used as a control was obtained from the blood of stock rabbits. These two serums were used in neutralization tests versus a laboratory strain of fixed rabies virus, the bat virus, and, in addition, a laboratory strain of western equine encephalitis virus which was included to establish the absence of nonspecific virucidal effects. At the time of the neutralization tests, only virus lots of low titer were available, and, therefore, the serums were tested against small doses of virus. However, the results were clear-cut: The known antirabies serum in a 1:10 dilution gave complete protection against 50 LD_{50} of the bat virus and 15 LD_{50} of known rabies virus (the largest doses tested) but failed to protect against even 1 LD_{50} of western equine encephalitis virus. The normal rabbit serum afforded no protection against any of the viruses. Refined and concentrated antirabies serum (Lederle) injected intraperitoneally in mice also protected the animals against both the bat virus and fixed rabies virus.

Vaccine Protection Tests

Vaccines were prepared by the method of Habel, Bell, and Wright (*2*) from the brains of mice injected with the bat virus and infected with fixed rabies virus. Sufficient numbers of mice were injected with each vaccine (*3*) to permit cross-immunization tests with groups of 12 mice per dilution. Normal mice of the same age were challenged as controls. Unfortunately, the fixed rabies challenge and control titrations were done with dilutions of suspensions of brain tissue rather than with dilutions of supernate. However, the results clearly indicate that both vaccines afforded significant protection against homologous and heterologous challenge (see table).

A few vaccinated mice were challenged via the intraperitoneal route with 0.1 ml. of a 10^1 dilution of fixed rabies virus suspension. The results follow:

1. Normal mice (controls): 6 of 6 injected dead within 10 days.
2. Mice vaccinated with fixed rabies virus vaccine: 1 of 5 injected dead on the 2d day, and therefore apparently was not specific.
3. Mice vaccinated with bat virus vaccine: 1 of 6 injected dead on 10th day.

Characteristics

In our limited experience with isolation of street virus, the long incubation period of this strain is unusual. Ernest Tierkel of the Communicable Disease Center, Atlanta, stated in a personal communication that a long incubation period is common in isolations from Florida bats but not in isolations from free-tailed bats (*Tadarida*) of the southwestern United States. The incubation periods in 3 rabbits injected intrathecally (cisternal puncture) with 0.2 ml. of a 10^2 dilution of the second mouse passage were 14, 15, and 24 days, respectively. Mice inoculated intracerebrally with 0.03 ml. of the same dilution became ill on the 10th day and all succumbed by the 15th day. A pool of brain tissue of the above rabbits was tested for virus content by titration in mice (10^2/0.03 ml.) and 0.2 ml. was injected intrathecally into 4 rabbits. One rabbit died suddenly on the 15th day. One developed paralysis on the 30th day. The latter animal had much virus in the brain whereas another 1 of the 4, sacrificed the same day and apparently normal, had none. The 4th rabbit was alive 60 days after injection. None of the affected rabbits showed evidence of a furious syndrome but developed rather sudden paralysis.

Results of vaccine protection tests

Experiment No.	Vaccine	Challenge	Titer log LD_{50}	Protection log LD_{50}
196:				
A	Fixed rabies	Bat virus	<2.0	>2.75
B	Bat virus	do	<2.0	>2.75
C		do	4.75	
D	Fixed rabies	Fixed rabies	<2.00	>4.00
E	Bat virus	do	3.87	>2.13
F		do	>6.00	

Mice that succumbed to infection usually developed paralysis in the hind quarters from one to several days before death. Seven mice injected with the virus developed the same paretic signs as many others injected at the same time but have not yet succumbed to the infection (45 days after injection) and appear to be in good health except for the paralytic sequelae which limit their movements. These animals are being studied further to establish, if possible, that they have survived active rabies infection.

Identification of the Bat

The formalin-fixed bat specimen was transferred to 70 percent alcohol and sent to the Division of Mammals, United States National Museum, Washington, D. C. There it was identified as *Eptesicus fuscus pallidus* Young by Dr. David H. Johnson and accessioned as No. 298459 in the mammal collection. While the skull had been damaged by removal of the brain, the dentition and other characters permitted specific identification. The range of this subspecies extends from the Great Plains westward nearly to the Pacific Coast and from Canada to Mexico. Upon our inquiry and reexamination of the specimen, Dr. Johnson replied that there was "no reason to doubt that it is a native of your vicinity." The question arose because of the recent prior arrival from Ohio of a canvas-covered trailer which was parked in the neighborhood where the bat was captured.

E. f. pallidus is a large insectivorous bat which is not known to migrate but hibernates in caves in the northern States (*4, 5*). The known range of movement is from 33 to 61 miles in summer and winter, respectively. Engler (*6*) states that they are cannibalistic in captivity.

Infection of Bats by Various Strains

Unfortunately, the identification of rabies in a bat came at a time when very few of the animals could be found in this area. Several reports of concentrations of bats were investigated, but in most cases only guano was present as evidence of previous habitation. A few ani-

mals, however, were recovered. Four specimens brought to the laboratory dead or which died soon afterwards were tested for rabies, but the virus was not demonstrated. Several other bats in good condition were maintained in the laboratory by feeding them on condensed milk and homogenized liver. Several of these (*E. f. pallidus*) were injected.

Bat 9194, injected intracerebrally with fixed virus, showed only mild irritability 25 days later. It was sacrificed that day and virus was detected by passage of brain tissue triturate to mice. It was notable that the incubation period of the disease in mice was several days longer than was usual for this strain. (It is possible, of course, that the bat was infected in nature before we collected it.) In the bat brain a few Negri bodies were seen in the pyramidal cells of the hippocampus but none in the Purkinje cells of the cerebellum.

Bat 9195, injected intracerebrally with bat virus (second mouse passage), showed tremors beginning on the 14th day. Weak, tremulous, ineffectual movements characterized the illness of this bat until it was sacrificed on the 25th day. Many small Negri bodies were noted in the hippocampus and multiple small Negri bodies in the Purkinje cells of the cerebellum. Inflammatory changes had occurred in the cerebral cortex and overlying meninges. The incubation period in mice injected with a suspension of brain from this bat was markedly shorter than in the case of bat 9194.

Discussion and Summary

A virus isolated from a sick bat in western Montana has been identified as rabies virus. The virus was subjected to neutralization and protection tests with known antirabies serums, and to cross-protection tests with vaccines prepared from the bat virus and from fixed rabies virus. The results of those tests clearly indicated an antigenic relationship between the viruses. Because of small quantitative differences in cross-immunity tests, it appears that the bat virus antigen may not be fully immunizing versus fixed rabies infection. This is the converse of the conclusions of Kubes and Gallia (*7*) in regard to chiropteran and Pasteur strains.

The incubation period of the disease in mice was prolonged in first passage but became shorter in serial passages. A titer of 10^3 LD_{50}/0.03 ml. was found in the original brain suspension.

Typical Negri bodies were seen in the brain of the original bat and also in two bats injected intracerebrally, one with fixed virus and the other with bat virus.

The bat from which the virus was isolated has been identified as *Eptesicus fuscus pallidus*, an insectivorous species indigenous to western United States. This is the first reported isolation from the species, and the northernmost isolation from a bat. The source of infection in the bat is conjectural. Rabies has not been reported in Montana since 1952 according to H. F. Wilkins, Montana State veterinary surgeon. Bats of the species *Eptesicus fuscus* are known to hibernate, but whether they may also migrate is not established.

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Observations in the vicinity of a central Texas cave inhabited by millions of Mexican free-tailed bats establish the presence of rabies in the bat population and suggest a hypothetical route of transmission to raccoons and other carnivores.

Wildlife Rabies in Texas

—*A Preliminary Report*—

By R. B. EADS, Ph.D., J. S. WISEMAN, M.S., J. E. GRIMES, B.A., and G. C. MENZIES, M.S.

RABIES is prevalent among Texas wild carnivore populations. In recent years the disease has been shown to occur in epizootic proportions in the gray fox, *Urocyon cinereoargenteus*, and skunks, chiefly *Mephitis mephitis* and *Spilogale* spp. (*1*).

In 1953 the Texas State Department of Health Laboratory confirmed positive findings of rabies in 150 foxes and 49 skunks taken from 44 and 20 counties, respectively. In 1954 it found rabies in 100 foxes and 71 skunks, from 33 and 29 counties, respectively. Occasionally, the laboratory has received wolves, coyotes, raccoons, and bobcats which laboratory tests proved to be positive for rabies.

Since animals are seldom submitted for laboratory examination unless they have invaded premises, usually diurnally, and have attacked domestic animals or human beings, it would seem obvious that the actual level of rabies infection among wild carnivores is much higher than our data indicate.

The recovery of rabies virus from insectivorous bats in Florida by Venters and his associates (*2*) and again in several other States by other investigators led to consideration of the role of bats in the maintenance and spread of the disease in nature.

In Texas, interest has centered around the Mexican free-tailed bat, *Tadarida mexicana*, as a transmitter of rabies to men and domestic and wild animals because this species is the most abundant and widespread in the State and virologists in the State health department have repeatedly recovered the virus in its brain and salivary gland material. These bats are commonly observed in natural retreats and buildings, and in the central part of Texas they are especially prevalent in certain limestone caves during all but the coldest winter months.

Dr. Eads is in charge of the entomology division, bureau of laboratories, Texas State Department of Health, which he joined in 1940. Mr. Wiseman and Mr. Grimes have been with the department since early 1953, Mr. Wiseman as an entomologist in the entomology division and Mr. Grimes as a virologist in the virus division, bureau of laboratories. Mr. Menzies is also a member of the entomology division. *Their investigations on bat rabies in Texas have been supported in part by a research grant from the Division of Research Grants and Fellowships, National Institute of Mental Health, Public Health Service.*

The teeth of *T. mexicana*, although sharp, are short and delicate. Hence, the means whereby the rabies virus could be transmitted to a furred and thick-skinned carnivore, such as the fox, skunk, or raccoon, appear limited. Two natural methods of infection transmission appear feasible:

Live, infected bats which become moribund and fall to the floor of the bat retreat may be able to inflict bites around or inside the mouths of animals attempting to devour them.

The rabies virus from an infected bat, if eaten, may penetrate the mucous membrane of the oral cavity, throat, or esophagus through an abrasion already present or possibly through an abrasion caused by a sharp bone.

Review of the Literature

Pursuant to the question of whether carnivores feed on bats, Allen (*3*) in his excellent book entitled "Bats," states, "Bats have few enemies." However, a search of the literature reveals an impressive list of mammals, as well as birds and reptiles, which feed on bats.

Campbell (*4*) tells of killing a "chicken snake" which had swallowed 14 bats from a colony in an old barn.

Davis (*5*) reports the recovery of a bat, *Molossus nigricans*, in good condition, which had been eaten by a rat snake, *Elaphe laeta*. We observed a colubrid snake consuming a free-tailed bat at the entrance of Ney Cave, near Bandera, Tex., in May 1954, but we do not know how the snake caught the bat. On another occasion, we saw a snake of comparable size and appearance at the same place, but it escaped into a rocky crevice before it could be collected.

Beer (*6*), Constantine (*7*), and Bailey (*8*) have recorded that predatory birds, such as hawks and owls, feed on bats, and on the Mexican free-tailed bat especially.

Sperry (*9*) recovered fragments of two silver-haired bats (*Lasionycteris noctivagans*) from the stomach contents of a skunk killed in January 1930, in Pisgah National Forest, North Carolina. At the same time and place, he also found a red bat, *Lasiurus borealis*, in the stomach of an opposum.

Taylor (*10*) in 1954 found that in Texas the red bat is a regular, although negligible, item of the diet of the ringtailed cat, *Bassariscus astutus*, during the summer months. This nocturnal animal is arboreal and would probably take a greater number of solitary bats from the trees in which the bats spend the day if the bats were not also nocturnal.

Goodpaster and Hoffmeister (*11*) captured three minks having the remains of *Myotis* bats in their stomach contents. They took the minks in Carter County, Ky., at Carter Cave, which is inhabited by bats only during the winter months. These authors stated that the bats were hanging near enough to the cave floor for the minks to have reached them by jumping.

Bat Rabies Investigations

As part of our overall bat rabies investigations in the Texas State Department of Health, we have made regular observations of one of the largest bat colonies in the United States, in Bracken Cave near San Antonio. Only about 1,000 feet long, from 40 to 100 feet wide, and from 30 to 75 feet high, the cave harbors a multimillion population of *T. mexicana* and an appreciable number of *Myotis velifer* except for certain of the winter months.

During December through January there were no bats at all in the cave. Presumably, the free-tailed bats migrate south, possibly into Mexico, during the winter season and thus come within the range of the vampire bat. Just how far southward *T. mexicana* travels has yet to be determined.

In an effort to learn more about the ecology of this species, 3 of us banded approximately 5,000 individuals during 5 trips to the study cave in September and October 1954. During March–May 1955, approximately 10,000 more bats, chiefly *T. mexicana*, have been banded in this and other central Texas bat caves.

We used insect nets with extension handles for raking the bats off the walls and ceilings of the cave and placed the captured bats in an apple box, the top and bottom of which we covered with screen wire, adding a sliding panel door to the top. When a box contained a few hundred bats, it was taken to the cave entrance for banding.

Using the banding method described by Trapido and Crowe (*12*), we placed zero-sized

Entrance to one of the bat caves in central Texas where the State health department is conducting rabies transmission and migration studies.

aluminum bird bands on the distal portion of the forearm and adjusted the bands to permit free sliding along the bone without pinching the wing membrane. The United States Fish and Wildlife Service supplied the bird bands.

We found that one person could fasten the bands, pinching them together, as rapidly as two others, wearing leather gloves, could remove the bats from the box and hold out the forearm for banding.

Working during the summer months in these caves is very unpleasant because the guano is more than a foot deep in spots, ammonia fumes are strong, ectoparasites are abundant, and the heat is intense.

Regular monthly collections of bats have been made from the study cave for laboratory examinations.

The table illustrates the frequency with which the virus of rabies was isolated from brains and salivary glands of *T. mexicana*. Our laboratory has processed 329 bats of this species from Bracken Cave, collected from May 1954 through April 1955 in 98 pools. Twelve of the pools contained the rabies virus.

The specimens used for the pools were bats which were taken with the aid of insect nets from the cave walls or in flight or they were found moribund on the floor of the cave.

Our studies demonstrated that there may have been a high level of rabies infection in the free-tailed bats during May 1954–April 1955. That the colony had an extremely high mortality rate was evidenced by the fact that the cave floor was covered with dermestid beetle larvae and adults which devoured fallen bats. The maintenance of such an enormous dermestid population would require an appreciable supply

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Rabies isolations from Tadarida mexicana taken in Bracken Cave, in central Texas, in 1954 and 1955

Date collected [1]	Number of bats	Number of pools	Number of positive pools	Source of virus
1954				
May 6	35	3	2	Brain and salivary glands.
June 29	37	5	1	Brain.
July 30	35	7	4	Brain and salivary glands.
Aug. 30	44	8	2	Do.
Sept. 21	27	6	2	Do.
Oct. 8	45	8	0	
Nov. 19	46	21	0	
1955				
Feb. 23	25	25	0	
Mar. 14	10	10	0	
Apr. 27	25	5	1	Do.
Total	329	98	12	

[1] During December 1954 and January 1955 there were no bats in the cave.

of dead bats. Skeletal remains of bats in the guano were abundant throughout the cave.

Our earliest observations during the spring of 1954 confirmed Constantine's report for the National Speleological Society (*7*) that the bat caves in central Texas attract large numbers of predatory mammals and birds. We found that raccoons, in particular, were far more abundant around the study cave than the food supply appeared to justify, unless they were feeding on bats. Large accumulations of raccoon feces were in evidence at the mouth of the cave throughout the summer, but raccoon tracks or droppings were not found within the cave. The droppings found at the entrance to the cave did not contain any bat skin or bones.

It was not until November 18, 1954, after most of the bats had departed from the cave, that we had definite evidence of raccoons eating bats in numbers. When we noticed that raccoon tracks were abundant throughout the cave, we searched for concentration of scats (feces). Several recently deposited accumulations of fecal material contained bat fur and bones; some of the scats contained nothing but the remains of 5 to 10 bats, but others also contained insect fragments and seeds of the black persimmon, a major item of the raccoon diet during the summer.

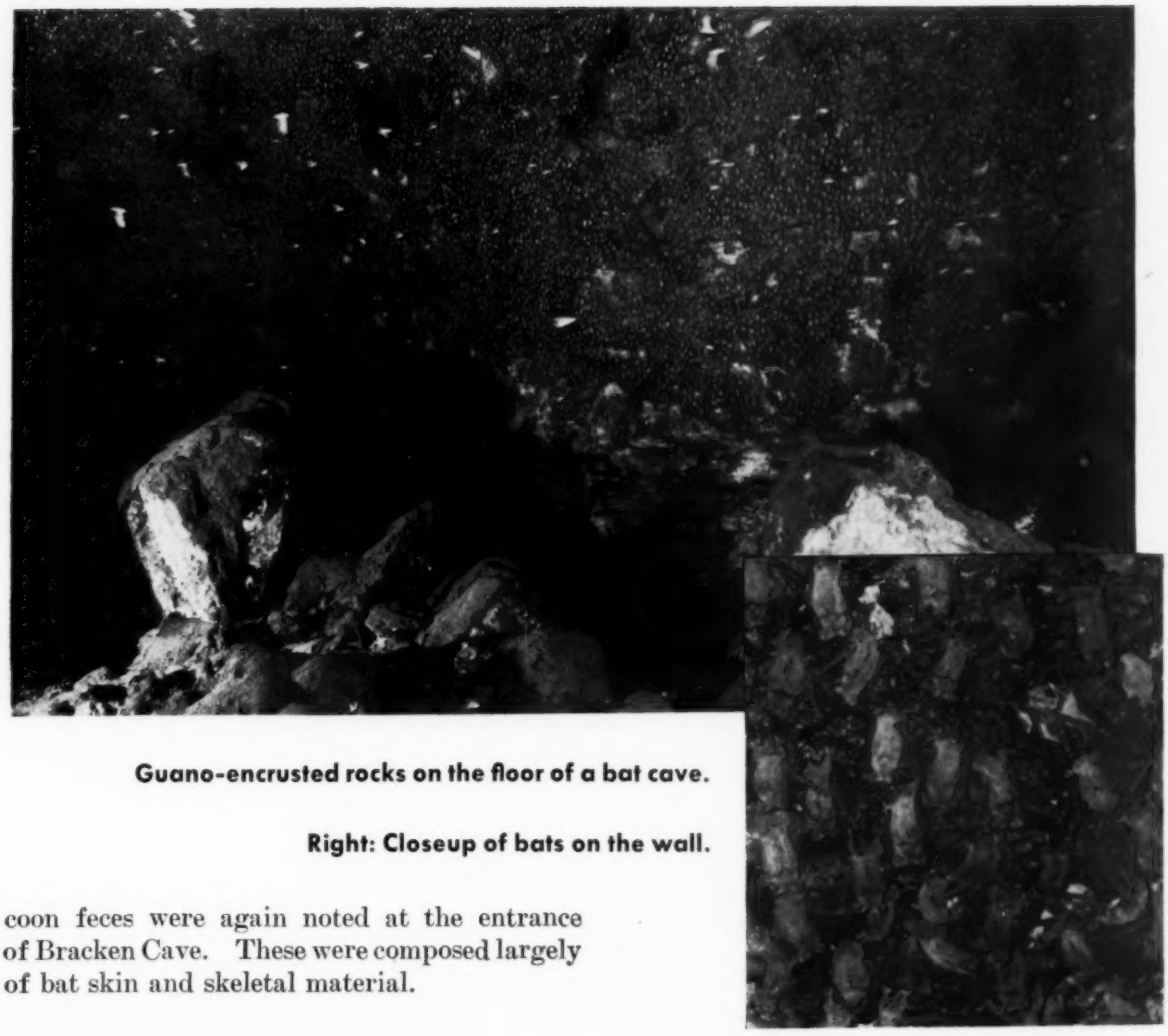
We were surprised to find in one of the scats an aluminum band still attached to a portion of bat fur and forearm. We identified the band as having come from a free-tailed bat banded in the study cave on September 29, 1954.

Migration had reduced the colony by November 1954 to a few thousand bats, hanging night and day from the highest ceiling area at the rear of the cave. With the advent of cold weather, the bats appeared to have discontinued their evening feeding flights, thus giving a raccoon or other carnivore little chance of reaching a bat unless it fell to the floor.

Early in December 1954 we baited 6 live traps with sardines and raw hamburger and set them in the study cave in order to collect raccoons for our bat-to-carnivore rabies transmission experiments. The first night of trapping produced 1 raccoon (*Procyon lotor*) and 2 damaged traps from which the raccoons had escaped. The second night we took 2 more raccoons from 4 traps within the cave. On the third night we baited 2 traps and took another raccoon. These animals freely fed on bats in the laboratory.

On April 28, 1955, large quantities of rac-

Banding Mexican free-tailed bats at a cave entrance.



Guano-encrusted rocks on the floor of a bat cave.

Right: Closeup of bats on the wall.

coon feces were again noted at the entrance of Bracken Cave. These were composed largely of bat skin and skeletal material.

A Hypothetical Explanation

The abundance of the raccoons and other carnivores in the vicinity of the large bat caves of central Texas strongly indicate that these animals occasionally feed on bats which fall near the cave entrances during the spring and late summer months.

Our observations show that in the autumn and spring, when other foods, and particularly the black persimmon, become less abundant or absent, raccoons enter the caves and actively search for fallen bats. For a limited period of time bats are an important dietary item of the raccoon in these restricted areas. Thus the possibility of the transmission of rabies from bats to these carnivores exists, but the exact mode of this potential interspecies transmission remains to be demonstrated.

Our investigations have established the isolation of the rabies virus from 12 out of 98 pools containing 329 bats during the period from May 6, 1954, to April 27, 1955, but the virus was not found in 64 pools containing 126 bats collected from October 1954 through March 1955. It seems probable that the presence of the disease might help to account for the number of bats that fall to the floor of the cave and serve as food for the raccoons.

This relationship provides a hypothetical explanation of the way in which rabies might pass from bats to raccoons. Evidence from the literature indicates the possibility of similar transfer to ringtailed cats, skunks, opposums, and other animals. However, the mechanism of transfer has not been found.

Summary

Investigators in the Texas State Department of Health report observations of a close association between Mexican free-tailed bats (*Tadarida mexicana*) and certain carnivores, especially the raccoon. During November 1954 and April 1955 they examined a number of raccoon droppings found within a central Texas cave inhabited by a colony of the free-tailed bats. The droppings were composed largely of bat fur and bone. The State health department laboratory has demonstrated a high level of rabies infection in the bat population within the study cave. Transmission of the rabies virus to raccoons and other carnivorous animals through the agency of infected bats is being investigated.

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Memorial to Dr. T. Duckett Jones

Support of young investigators and long-range medical research is promised by a fund recently established in honor of Dr. T. Duckett Jones, who died in 1954.

Jones was medical director of the Helen Hay Whitney Foundation, which is cooperating with the memorial committee. He advocated the creation of long-tenure positions for experienced investigators in universities and research institutions and aid to carefully selected, unrecognized researchers which might permit them to demonstrate their competency. His ideas and suggestions influenced research programs of a number of American institutions, including the National Institutes of Health and the American Heart Association.

The committee feels that research in rheumatic fever, the subject of much of Jones' own research activity, should be given first consideration in the assignment of its resources, but not an exclusive claim.

Mrs. James B. Campbell is chairman of the committee. Other members are Dr. E. Cowles Andrus, Dr. Walter Bauer, Dr. Francis L. Chamberlain, Mrs. Albert D. Lasker, Dr. H. M. Marvin, Dr. Jean Jones Perdue, Dr. David D. Rutstein, Dr. Leonard A. Scheele, Dr. Frederick K. Trask, and Dr. Paul D. White.

The incidence of Trichinella spiralis in the area of Louisville-Jefferson County, Ky., as determined by examining the diaphragms of humans autopsied at the Louisville General Hospital and of swine slaughtered in the Louisville abattoirs.

Trichinella spiralis in the Diaphragms of Humans and Swine

By LETITIA S. KIMSEY, M.D., and STUART L. ADAMS, Ph.D.

INTEREST in the control of trichinosis as a public health measure was awakened by the First National Conference on Trichinosis in 1952, and an amended recommendation of the 1954 Conference on Trichinosis (*1*) emphasized the continuing importance of data on the prevalence of this disease. The amended recommendation stated:

"Because of the advantages of having up-to-date information concerning the incidence of trichinosis in man, and in view of a decreased incidence of trichinous infection encountered in swine, the United States Public Health Service is requested to repeat the random survey of human trichinosis carried out by that agency between 1936 and 1941."

Even though the study here reported was conducted a decade ago, the data should be useful statistically since there are no published data on the incidence of trichinosis in either the human or porcine population of Kentucky.

Dr. Kimsey is assistant professor of microbiology, and Dr. Adams is a research associate in the department of microbiology, University of Louisville School of Medicine, Louisville, Ky. Dr. Adams is also director of research at Joseph E. Seagram & Sons, Inc.

Individual reports of the investigation described have been submitted to the Graduate School of the University of Louisville in partial fulfillment of requirements for the degree of master of science. Dr. Kimsey's report, "The incidence of infestation with Trichinella spiralis as revealed by the examination of 570 diaphragms at the Louisville General Hospital, Louisville, Ky.," was submitted in 1943; Dr. Adams' report, "The incidence of Trichinella spiralis in the diaphragms of swine from the Louisville abattoirs," in 1942.

Materials and Methods

Using essentially the same methods, one author investigated the incidence of *Trichinella spiralis* in the diaphragms of humans and the other studied the incidence of the parasite in the diaphragms of swine.

Study of Human Diaphragms

The material used in the study of infestation of humans consisted of a series of diaphragms removed at routine autopsy at the Louisville General Hospital, Louisville, Ky. Except for the exclusion of diaphragms of children under

1 year of age, there was no conscious selection of subjects. The investigation was divided into two series and the results were interpreted and reported separately.

Series 1 consisted of 311 diaphragms placed directly in 10 percent formalin when removed from the body and later examined by a modification of the direct microscopic method employed by Nolan and Bozicevich (*2*). A gram of muscle from which tendinous material had been removed, taken at random from various parts of the diaphragm, was teased into pieces and firmly pressed between two glass plates. The positive findings were recorded in terms of trichinae per gram of diaphragm as revealed by the examination of the pressed preparation, using a wide-field microscope with a 12.5 ocular and a 1.7 objective.

Series 2 consisted of 259 diaphragms which were examined by both the direct microscopic and the digestion techniques. The diaphragms were removed at routine autopsy and kept in jars of fresh water at icebox temperature until time of examination. The specimens were then carefully dissected, and four 1-cm.-wide strips taken from different locations on the circumference of the diaphragm were cut parallel to the direction of the muscle fibers, care being taken to include the tendinous insertions. The strips were placed in 10 percent formalin, and all four were examined later by the direct microscopic method employed in series 1.

The digestion method used was a modification of the digestion-Baermann technique described by Queen (*3*) in 1931. The portion of the diaphragm that remained after the material for the direct microscopic examination had been removed was finely ground and digested by artificial gastric juice, which consisted of 0.5 percent hydrochloric acid and 0.7 percent commercial pepsin in an aqueous solution. A liter of this digestion material was added to approximately 50 gm. of the ground muscle, and the mixture was simultaneously agitated mechanically and incubated at 37° C. for a period of 12 hours. The mixture was allowed to settle for an equal period of time, and the sediment then was filtered through cheesecloth and later through a No. 3 Coors porcelain desiccator plate placed in a funnel. The sediment from this filtration was centrifuged and the deposit was poured into a Petri dish for microscopic study with a dissecting microscope with a 20-diameter magnification. There was no quantitative report as to the larvae per gram of digested diaphragm. The detection of larvae in any fraction of the centrifuged sediment constituted a positive finding.

Study of Swine Diaphragms

One thousand swine diaphragms were taken by random selection immediately prior to Government inspection of the viscera of the animals. These diaphragms were collected from 4 abattoirs over a period of 9 months in order to insure representative sampling of the swine slaughtered in the Louisville market.

Table 1. Human diaphragms positive for Trichinella spiralis by direct microscopic method only (series 1)

Serial No.	Age (years)	Sex	Race	Eosinophils in blood (percent)	Cysts per gram of diaphragm
1	16	M	W	0	1
2	59	M	N	2	1
3	29	F	N	N.D.	4
4	40	F	N	0	13
5	74	M	W	0	1
6	46	F	W	0	4
7	64	F	N	0	51
8	34	F	N	0	1
9	39	M	N	N.D.	2
10	67	M	W	0	1
11	57	M	N	0	2
12	55	M	N	N. D.	3
13	61	M	W	0	2
14	58	F	N	1	75
15	68	M	N	0	6
16	60	F	N	N. D.	4
17	39	F	N	0	4, 500
18	72	F	W	0	3
19	34	M	W	N. D.	1
20	40	M	W	N. D.	2
21	59	M	N	N. D.	2
22	71	M	W	N. D.	4
23	37	M	N	1	3
24	79	M	N	2	3
25	61	M	W	N. D.	1
26	30	M	N	0	2
27	60	M	N	N. D.	408
28	79	M	N	0	5
29	49	F	N	0	1
30	54	M	W	0	3
31	74	F	W	0	8
32	36	M	W	0	1
33	62	F	W	1	1
34	71	M	W	1	3
35 [1]					3

N. D. No blood count made.

[1] Tag lost, diaphragm saved.

The method of preservation of the swine diaphragms was the same as that employed for human diaphragms. The diaphragms were examined by both the direct microscopic and the digestion techniques. In the direct microscopic examination, the fascia was removed from the diaphragm, and one-half gram of muscle taken from various parts of the organ was cut into small thin strips and examined in the manner described for the human diaphragms.

The digestion method employed early in the study of the swine diaphragms was the previously described modification of the Baermann technique. All of the diaphragm that remained after the sample for the direct microscopic study had been removed was ground and digested in 3 liters of the artificial gastric juice for 24 hours at 37° C., with constant mechanical agitation. There was no other modification of the technique. However, after 107 diaphragms had been examined, the mass digestion procedure of Hood and Olsen (*4*) was adopted. The diaphragms were stripped of the tendon and fat and 10-gram portions from each of 10 or 20 diaphragms were digested together. The remainder of each diaphragm was retained so that the specimens might be examined individually if larvae were found in the mass digestion. One liter of artificial gastric juice was used to digest 50 gm. of diaphragm.

Results

Human Diaphragms

Series 1. Of the 311 human diaphragms examined by the direct microscopic method alone, 35 (11.2 percent) were found to contain *Trichinella spiralis*. The more important data concerning the group are shown in table 1.

The density of infestation varied from 1 cyst per gram to 4,500 cysts per gram of diaphragm.

The ages of the patients varied from 1 to 88 years. Of the 311 diaphragms examined, 99 (31.8 percent) were from persons less than 40 years of age at death; 188 (60.5 percent) were from persons dying at between 40 and 80 years of age; and 3 (0.9 percent) were from persons over 80 years of age. The ages of 21 individuals (6.8 percent) were unknown. These persons were dead upon arrival at the hospital—in most instances, coroner's cases—or they died before a history could be obtained.

The age distribution of the patients with *T. spiralis* infestation is shown in table 2. Of the 23 diaphragms of patients in the first two decades of life, only 1, that of a boy 16 years of age, showed presence of trichinae. Four percent of the group aged 20–29 years and 8.1 percent of the group aged 40–49 years revealed infestation with *T. spiralis*. In each of the other decades (through the seventh), the incidence of infestation was over 13 percent. The highest incidence (18.4 percent) fell in the group aged 70–79 years. The highest percentage (22.8) of the 35 positive cases fell in the group aged 60–69 years.

The incidence of trichinosis by race and sex of the patients is recorded in table 3. Of the 311 diaphragms examined, 184 were from males and 108, from females. The race and sex of 19 patients were not recorded. Twenty-two (11.9 percent) of the 184 males and 12 (11.1 percent) of the 108 females were infested with trichinae. One positive diaphragm was found among the 19 patients of unknown race and sex. Of the 292 persons whose race and sex were recorded, 171 were white, 14 (8.2 percent) being infested with trichinae. Twenty (16.5 percent) of the 121 Negro patients harbored encysted larvae. The highest incidence of in-

Table 2. Results of examination of human diaphragms for Trichinella spiralis by direct microscopic method only (series 1), by age distribution of patients

Age (years)	Number diaphragms examined	Positive		
		Number	Percent	Percent of total positives
1–9	11	0	0	0
10–19	12	1	8.3	2.9
20–29	25	1	4.0	2.9
30–39	51	7	13.7	20.0
40–49	49	4	8.1	11.4
50–59	45	6	13.3	17.1
60–69	56	8	14.2	22.8
70–79	38	7	18.4	20.0
80 and over	3	0	0	0
Unknown [1]	21	1	4.7	2.9
Total	311	35	11.2	100.0

[1] Tags lost, diaphragms saved.

festation (18.1 percent) occurred in Negro males; the lowest (7.5 percent), in white females. The white males showed an incidence of 8.4 percent; the Negro females, 14.5 percent.

Series 2. Of the 259 diaphragms examined by both the direct microscopic and digestion methods, 54 (20.8 percent) showed the presence of *T. spiralis*. Of these 54 positive cases, 13 (24.1 percent) were not detected by the digestion method and 7 (12.9 percent) were not revealed by the direct microscopic method. Thirty-four (63.0 percent) were positive by both methods. By the digestion method, 41 (15.8 percent) of the total diaphragms were positive; by the direct microscopic method, 47 (18.1 percent). Of the total positives, 75.9 percent were detected by the digestion method and 87.0 percent by the direct method.

The more important data concerning these positive cases are shown in table 4.

The density of infestation as determined by the direct microscopic method varied from 2 cysts per gram to 73 cysts per gram of diaphragm. Since the modified digestion-Baermann technique was not carried out quantitatively, it was assumed that if the direct microscopic test on a diaphragm failed to reveal any organisms and trichinae were found by the digestion technique, the diaphragm contained less than two cysts per gram.

The ages of the patients in this series varied from 1 to 86 years. Of the diaphragms examined, 70 (27.0 percent) were from persons less than 40 years of age; 174 (67.2 percent) were from persons dying between 40 and 80

Table 3. Incidence of Trichinella spiralis in human diaphragms examined by direct microscopic method only (series 1), by sex and race of patient

Sex and race	Number diaphragms examined	Infested	
		Number	Percent
Total	311	35	11.2
Male	184	22	11.9
White	118	10	8.4
Negro	66	12	18.1
Female	108	12	11.1
White	53	4	7.5
Negro	55	8	14.5
Unknown	19	1	5.2

Table 4. Human diaphragms positive for Trichinella spiralis by both the direct microscopic and modified digestion-Baermann methods (series 2)

Serial No.	Age	Sex	Race	Eosinophils in blood (percent)	Direct microscopic method (cysts per gram of diaphragm)	Modified digestion-Baermann method
1	60	F	N	0	15	Positive
2	68	F	N	N. D.	20	Do.
3	86	M	N	N. D.	8	Negative
4	59	M	N	2	4	Positive
5	68	F	N	0	70	Do.
6	66	M	N	0	5	Do.
7	44	F	N	0	10	Negative
8	53	M	W	0	2	Do.
9	37	M	W	0	2	Do.
10	57	F	W	0	4	Do.
11	55	F	W	0	2	Positive
12	49	F	W	0	2	Negative
13	66	M	W	1	4	Do.
14	54	M	W	2	0	Positive [1]
15	57	F	W	1	0	Do. [1]
16	64	M	N	0	4	Positive
17	67	M	W	1	34	Do.
18	44	F	W	3	4	Negative
19	45	F	N	2	10	Positive
20	40	M	W	0	38	Negative
21	45	F	N	0	0	Positive [1]
22	52	M	W	1	4	Positive
23	60	F	N	N. D.	4	Do.
24	70	M	N	N. D.	40	Do.
25	83	M	W	N. D.	4	Do.
26	82	F	W	0	6	Do.
27	65	M	N	0	2	Do.
28	29	F	W	0	10	Do.
29	51	M	W	4	0	Positive [1]
30	65	M	W	N. D.	4	Positive
31	73	F	W	0	73	Do.
32	71	M	W	0	3	Do.
33	67	F	W	0	2	Negative
34	72	F	N	0	4	Do.
35	56	M	W	N. D.	4	Positive
36	...	M	N	N. D.	0	Positive [1]
37	68	F	W	1	0	Do. [1]
38	73	M	W	0	8	Positive
39	67	M	W	1	3	Do.
40	57	F	W	0	6	Do.
41	34	M	W	3	2	Do.
42	67	M	W	N. D.	3	Do.
43	34	M	N	0	6	Do.
44	50	M	N	N. D.	7	Do.
45	47	M	N	1	0	Positive [1]
46	54	M	N	N. D.	14	Positive
47	32	M	W	0	14	Negative
48	37	F	N	0	2	Do.
49	17	M	W	0	5	Positive
50	30	M	N	0	3	Do.
51	26	F	W	0	10	Do.
52	76	F	W	0	21	Do.
53	75	M	N	N. D.	32	Do.
54 [2]	...	...	...	...	11	Do.

N. D. = No blood count made.

[1] Less than 2 cysts per gram. [2] Tag lost, diaphragm saved.

years of age; and 6 (2.3 percent) were from persons over 80 years of age. The ages of 9 individuals (3.5 percent of the 259) are unknown. They were dead upon arrival at the hospital or died before a history could be obtained.

The ages of patients in this series are shown by decades in table 5. Only 1 diaphragm of the 25 examined from persons in the first two decades of life contained trichinae. This was a diaphragm of a white male 17 years of age. In the other seven decades of life the lowest percentage of positives was 13.3 percent, in the 20–29-year age group. Fifty percent, 3 of the 6 cases in the 80–89-year age group were positive. Of the 54 positive cases, the highest incidence (25.9 percent) was in the 60–69-year age group.

Table 5. Results of examination of human diaphragms for Trichinella spiralis by both direct microscopic and modified digestion-Baermann methods (series 2), by age distribution of patients

Age (years)	Number diaphragms examined	Positive		
		Number	Percent	Percent of total positives
1–9	13	0	0	0
10–19	12	1	8.3	1.8
20–29	15	2	13.3	3.7
30–39	30	6	20.0	11.1
40–49	40	7	17.5	13.0
50–59	53	12	22.6	22.2
60–69	51	14	27.4	25.9
70–79	30	7	23.3	13.0
80 and over	6	3	50.0	5.6
Unknown [1]	9	2	22.2	3.7
Total	259	54	20.8	100.0

[1] Tags lost, diaphragms saved.

The incidence of trichinae by sex and race of the patient is recorded in table 6. Of the 259 cases examined, 182 were males and 72, females. The sex and race of 5 patients were not recorded. Of the 182 males examined, 31 (17.0 percent) were infested with trichinae. Twenty-two (30.5 percent) of the 72 females were found to be parasitized. One positive diaphragm occurred among the five patients of unknown sex and race. Of the 254 persons whose sex and race were recorded, 154 were white, and 31 (20.1 percent) of these were infested with *T. spiralis*.

Twenty-two percent of the 100 Negro patients harbored encysted trichinae. The highest incidence (33.3 percent) occurred in white females; the lowest incidence (15.6 percent), in white males. The Negro males showed an incidence of 19.4 percent and the Negro females, 27.2 percent.

A differential blood count was performed in 24 of the 35 patients whose diaphragms were examined in series 1 (table 1). Of these 24 patients, only 6 showed eosinophils, the greatest number in any patient being 2.0 percent of the total count. Of the 41 patients in series 2 whose diaphragms contained trichinae and upon whom a differential blood count was made, only 13 were found to have eosinophils. The highest incidence was 4.0 percent. There were no eosinophils in 28 of the 41 patients.

Swine Diaphragms

Of the 1,000 swine diaphragms examined, only 2 were found to contain trichinae by the digestion method and 1, by the direct microscopic method. The one specimen found positive by direct examination was also positive by digestion. Thus, the incidence of infestation in the group studied was 0.2 percent.

Discussion

The human diaphragms used in this study were removed at routine autopsy at the Louis-

Table 6. Incidence of Trichinella spiralis in human diaphragms examined by both direct microscopic and modified digestion-Baermann methods (series 2), by sex and race of patient

Sex and race	Number diaphragms examined	Infested	
		Number	Percent
Total	259	54	20.8
Male	182	31	17.0
White	115	18	15.6
Negro	67	13	19.4
Female	72	22	30.5
White	39	13	33.3
Negro	33	9	27.2
Unknown	5	1	20.0

ville General Hospital, Louisville, Ky. Aside from the exclusion of children under 1 year of age, there was no selection of specimens by age, sex, race, occupation, or clinical history of the patients. The presence of the organism was not suspected clinically in any of the 89 individuals who harbored cysts. Several patients gave vague histories of rheumatism or "growing pains" but these symptoms could well be attributed to some condition other than infestation with trichinae. Schwartz (*5*) explains in his article on the occurrence, significance, and control of trichinosis that the presence of trichinae in the diaphragm at autopsy does not mean that the person necessarily had previously existing clinical trichinosis. Those persons with relatively few trichinae per gram of diaphragm probably experienced little, if any, inconvenience, and their medical histories would not suggest the symptoms characteristic of the clinical entity called trichinosis. Schwartz states that these light infections have only zoological significance, and the surveys demonstrate that trichinae is consumed in pork eaten by the public and that many Americans eat insufficiently cooked or inadequately cured pork.

By the direct microscopic method, 35 (11.2 percent) of the 311 diaphragms of series 1 were found to contain *T. spiralis*, and 47 (18.1 percent) of the 259 diaphragms of series 2 were positive. When subjected to statistical analysis, however, the difference in incidence of trichinae in the two series was insignificant.

There was a marked difference in the incidence of infestation with trichinae in the human diaphragms as determined by the direct microscopic examination in series 1 and that detected by the combination of the direct microscopic and the modified digestion-Baermann methods in series 2. This discrepancy between results of the direct microscopic method and the digestion method is to be expected from the work of Hall and Collins (*6*), who found that either method alone failed to detect trichinae in a certain number of cases. This fact has been supported by the findings of Nolan and Bozicevich (*2*), who stated that the microscopic method failed in a number of cases of light infestation. Conversely, the digestion method was reliable in detecting even very light infestations, although it was valueless in detecting dead trichinae.

The 20.8 percent of human infestation with trichinae as determined by the combined direct microscopic and modified digestion-Baermann tests is rather high for this area of the country. The southern States have, according to other investigators, a much lower incidence of trichinosis than that reported in other geographic sections of the United States. Hinman (*7*) in 1936 reported that 7 (3.5 percent) of 200 diaphragms from human autopsies at the Charity Hospital, New Orleans, La., were positive for trichinae when examined by the digestion method.

Sawitz (*8*), in a study of 200 autopsies from the Touro Infirmary and Charity Hospital, New Orleans, found that 5.0 percent contained *T. spiralis*. The diaphragms and pectoral muscles were examined by the compression and digestion methods. Two years later, in 1939, Sawitz (*9*) published an article on the incidence of trichinosis in man, dogs, and cats in the New Orleans area. In addition to the 200 cases just described, his study included material from 200 unselected routine autopsies of patients from the same institutions. Essentially, the same methods of examination were employed. Of the 400 cases, larvae of *T. spiralis* were found in 24, an incidence of 6.0 percent in the human population of the New Orleans area.

Meleney (*10*), in 1941, reported that among 209 human diaphragms from persons who died at the Vanderbilt University Hospital and the Nashville General Hospital, in Nashville, Tenn., 10 percent were positive for *T. spiralis* when examined by the combined digestion and microscopic press methods. However, in a preliminary report on the incidence of trichinosis in Alabama, Walker and Breckenridge (*11*) in 1938 reported that they had examined the diaphragm, intercostal, pectoral, and rectus abdominis muscles from 100 patients at autopsy by the digestion and press methods and found an incidence of 33 percent.

In 1943, the results of a very extensive survey of the incidence of *T. spiralis* in the population of the United States were published by Wright, Kerr, and Jacobs (*12*). Diaphragms were examined from a total of 5,313 individuals coming

to necropsy in 189 hospitals located in 114 cities in 37 States and the District of Columbia. These diaphragms were examined by both the direct microscopic and the digestion-Baermann methods. Of these 5,313 diaphragms, 855 (16.1 percent) were positive for *T. spiralis*. Omitting results of examination in a series of 200 diaphragms from persons of Jewish faith, of which only one was positive, the representative cases totaled 5,113, of which 854 (16.7 percent) were positive. Several papers in the series contained summaries of the finding of trichinae in surveys conducted by other investigators already referred to in this article. Although no statistics were given for Kentucky, the State was included in the East South Central group with Tennessee, Alabama, and Mississippi. Of the total 5,313 diaphragms examined, 85 were from this area and 15 (17.6 percent) of these were positive for trichinae. However, the interpretation was to the effect that, on the basis of this small number of cases, conclusions could not be drawn as to the probable incidence of human infection with trichinae in these areas.

Even though trichinosis has been a reportable disease in Louisville since 1917, an examination of the Louisville and Jefferson County Health Department records for the past 20 years failed to disclose a single case.

The low incidence of trichinosis in the south is explained by the fact that the majority of hogs in that area are peanut or grain fed, whereas many of those in more densely populated sections of the country are garbage fed. Hall (*13*) stated that the incidence of trichinae in swine is approximately as follows: Pasture-raised swine, mostly in the midwest, are free or practically free from trichinae. The so-called grain-fed swine in the midwest are in reality a mixture of some pasture-raised and some garbage-fed swine, and the mixture has an average infestation of about 1.5 percent. Southern swine have an average infestation of less than 1 percent. Garbage-fed hogs, which are more numerous along the southern part of the Pacific coast and the northern part of the Atlantic coast, have an average incidence of about 5 percent. The last group, which has practically disappeared, is the offal-fed hog, which has the highest incidence of infestation, about 18 percent.

The swine examined in the present study would be classified by Hall and others as grain fed, for, although the exact feeding could not be determined precisely, these swine were raised in a section of the country in which grain feeding predominates and were purchased for slaughter in the belief that they had been grain fed. It is estimated that approximately 50 percent of the swine were raised within a 100-mile radius of Louisville and that the remaining 50 percent were predominantly from north central Indiana and Illinois. The 0.2 percent infestation found in these swine is lower than the average given by Hall. However, similarly low incidences have been found in some other surveys. For example, Kerr (*14*) found 3 cases of infestation in a group of 566 grain-fed swine examined, and Cameron (*15*) in 1940 reported 2 positives in a group of 995 swine examined in Canada. It is evident that with such a small number of positives a difference of several tenths of 1 percent is not significant.

In 1953, Schwartz (*5*) reported a survey conducted over a 3-year period in which the diaphragms of 3,031 hogs from the midwest (Corn Belt hogs) were examined by the digestion method and 19 (0.63 percent) were found to harbor trichinae. The direct microscopic examination of small samples from a fairly large proportion of these diaphragms gave consistently negative results. The maximum number of parasites recovered from any diaphragm was between 7 and 8 per gram, most containing only 5 trichinae per 1,000 grams to 2 trichinae per gram. A parallel study of garbage-fed hogs carried out during the same period on 1,328 diaphragms revealed 149 (11.21 percent) infected with trichinae when the digestion method was used. Sixty-four (4.81 percent) of the diaphragms were found to be infected when examined by the direct microscopic method alone, and counts by the artificial digestion method were 100 or more parasites per gram of tissue. In 1 case there were 2,741 parasites per gram of tissue.

The greater part of the pork consumed by the people of Louisville is from hogs that have been slaughtered in the local abattoirs. Louisville maintains meat inspection and slaughterhouse ordinances, and no meat is placed on the local market until it has been inspected and

passed by a duly authorized inspector of the United States Government or by an authorized inspector of the Louisville and Jefferson County Health Department. However, the routine inspection does not include an examination for trichina larvae.

To be able to draw a comparison between the incidence of trichinosis in humans and in swine in the Louisville area as shown by this study, it becomes necessary to consider those factors which can account for the difference between 0.2 percent infestation in swine and 20.8 percent infestation in humans. First, it is possible that the high incidence of trichinous infestation in patients in the Louisville General Hospital may not be representative of the population as a whole. A large percentage of these patients are charity cases and their economic and social status tends to be low. Pork, particularly sausage, probably was a common item of the diet since it is usually less expensive than other meat. It is possible that some of these patients consumed large quantities of so-called country sausage. Second, records of these patients with respect to period of residency in the city are incomplete, and it is reasonable to suppose that a large portion of the life of at least some of them was spent in other localities. Third, one infected hog can be the source of disease for a large number of persons, and, by the same token, during a lifetime the average individual consumes meat from an extremely large number of hogs.

Peres (*16*) in 1942 reported the data from surveys conducted by different investigators almost simultaneously engaged in the study of the incidence of *T. spiralis* in the human and porcine population of the New Orleans area. The incidence in both the human and porcine populations was lower than that found in this study, but Peres likewise found a sharp difference between the incidence of trichinae in the two groups. He used the statistics of Hinman (*7*) and Sawitz (*9*) for the incidence of trichinae in man. Studying 2 square inches of diaphragm from each of 200 autopsies, Hinman found an incidence of trichinae of 3.5 percent. Sawitz, using larger samples and examining diaphragms obtained from 400 autopsies, found the incidence to be 6 percent. Peres during 1938 and 1939 examined the diaphragms of 516 southern hogs and the loins of 399 midwestern hogs for the presence of *T. spiralis* in the artificially digested material. None was found infected with trichinae. Likewise, none of 50 samples of sausage from local butchers revealed infection. Pork consumed in the New Orleans area comes from hogs that are raised in the south (Louisiana, Mississsippi, and Alabama), hogs that are raised on the outskirts of the city, and those that are raised in the midwest. Those hogs from the outskirts are raised mostly on garbage; those from the other parts of the south are allowed to roam the fields and to feed on peanuts; and those from the midwest are raised largely on grain. About four-fifths of the hogs consumed in the New Orleans area are from the midwest. Certainly, the low incidence agrees with the low infection rate in man in the New Orleans area, as contrasted with other areas of the United States.

Summary

The direct microscopic examination of 311 human diaphragms from routine autopsies at the Louisville General Hospital, Louisville, Ky., revealed an 11.2 percent incidence of *Trichinella spiralis*. A second series of examinations, using both the direct microscopic method and a modification of the digestion-Baermann methods, detected an incidence of 20.8 percent in the 259 human diaphragms studied. No selection of material was made, except that the diaphragms of all children under 1 year of age were excluded.

No conclusion could be drawn statistically as to the difference in incidence of infestation with *T. spiralis* by race, sex, or age because of the limited number of patients in each category.

The incidence of human infestation with trichinae in Louisville is somewhat higher than that reported by other investigators in studies of human diaphragms taken at autopsy in various other cities in the southern part of the United States. However, there is no statistically significant difference between the incidence of *T. spiralis* reported in this study and that found by Wright in either the human population of the United States as a whole or in that section designated by him as the East

South Central group of States to which Kentucky belongs.

In the examination of 1,000 diaphragms collected from swine slaughtered in Louisville abattoirs, 2 were found infested with trichinae by a modification of the digestion-Baermann method and one of these was also found infested by the direct microscopic method, an incidence of 0.2 percent. Although the exact type of feed is unknown, these swine may be classified as grain fed in conformity with the method used by Hall and others of classifying swine according to the type of feeding most prevalent in the section of the country in which the swine were raised. The incidence reported here is lower than the estimated average of 1.5 percent for the United States, but many other investigators have reported similarly low degrees of infestation.

ACKNOWLEDGMENTS

The authors wish to express their appreciation for the assistance given them in the preparation of this paper. They are especially grateful to Drs. J. A. Kennedy, A. J. Miller, and Malcolm L. Barnes of the University of Louisville School of Medicine, who directed the investigation, and to Dorothy Hampton Woerner for the statistical treatment of the data.

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PHR

Neisseria meningitidis Isolated From Case Of Acute Conjunctivitis

By Hugh Miller, Jr., B.S.

The identification of the etiological agent in conjunctivitis more often confronts hospital or clinic laboratories than a public health laboratory, but it is a matter of public health interest. The principle involved here applies whenever a Neisseria organism of any kind, not only gonococcus, is suspected. The implication is that reliance on simple microscopic procedure and the acceptance of misleading shortcuts can lead to major error.

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A CASE of uncomplicated conjunctivitis occurring in April 1953 was found to be due to *Neisseria meningitidis* as the result of bacteriological studies made by the San Benito County Health Department in California.

Smear preparations alone are frequently employed for recognizing the gonococcus from genitourinary tract secretions. Ordinarily, this procedure would present no problem. It entails, however, the risk of ascribing an incorrect etiological agent to the disease process and of incorrect clinical and epidemiological interpretation, particularly in the case of extragenital infections.

Gram-negative intracellular diplococci were demonstrated on smear preparations of the discharge from acute, purulent conjunctivitis of one day's duration of the right eye in a 4-year-old boy. Cultures were requested prior to treatment and were submitted. The patient responded well to the parenteral administration of 900,000 units of penicillin procaine G followed by 300,000 units per day for 6 days. Symptoms were absent at 48 hours.

The discharge was plated on chocolate agar with the addition of Difco's Bacto supplement A as recommended for 24-hour gonococcus cultures (*1*). These plates were incubated at 37° C. in a candle jar. Within 24 hours, numerous gray, opaque colonies with an entire edge were present. They were oxidase-positive and showed morphology typical of *Neisseria* by Gram stain. By biochemical test the culture was identified as the meningococcus. Serologically, the organism was placed in group 2.

Since this case was at first considered to be gonorrhea, considerable investigation was made of family and other contacts. Investigative work could be more rationally directed if cases of extragenitourinary *Neisserian* infections were first proved bacteriologically. Bacteriological proof of such infections would avoid also the social, medical, and legal implications usually associated with gonococcal infections in children. It should be noted that Thygeson (*2*) calls attention to the clinical similarity of inflammation of the eye by the gonococcus and the meningococcus and to the resultant need for bacteriological studies to establish an etiological diagnosis.

Mr. Miller, now laboratory director of the Merced County Health Department in California, was a bacteriologist at the San Benito County Health Department, Hollister, Calif., at the time of this report. The clinical information on the case was provided by Roswell L. Hull, M.D. Bacteriological and serologic confirmation of the cultures was made by Jean Johnston of the Oakland (Calif.) Department of Public Health, the division of laboratories of the California State Department of Public Health, and the Communicable Disease Center of the Public Health Service.

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Health Education for Palestine Arab Refugees

By THERON H. BUTTERWORTH, Ph.D.

THE UNITED NATIONS Relief and Works Agency for Palestine Refugees (UNRWA) in 1951 requested the assistance of the World Health Organization in evaluating its activities and developing future plans for public health education. The World Health Organization met this request by loaning a health educator to the Agency for 2½ months during the summer of 1952.

The WHO health educator worked with the staff of the UNRWA headquarters office in Beirut and with Agency's country headquarters' staff in Lebanon, Syria, Jordan, and the Gaza strip, formerly under the Palestine mandate, now under Egyptian control. He visited representative field health programs of the Agency in all these countries and held discussions on health problems and health education with staff groups and with the Arab refugees from Palestine.

In most of this work the health educator had the valuable assistance of a refugee who was employed by the Agency and who had received some special training in health education from the Egyptian Government. This assistant had been a camp sanitation officer and a camp leader and was well acquainted with the refugees in the camps and with their problems.

Mr. Butterworth is health educator with the World Health Organization, Geneva, Switzerland. Before joining WHO he was assistant chief of the Health Education Division, Public Health Service, Washington, D. C.

Clarification of the meaning of health education was a major objective in the consultant's day-by-day meetings with individuals and with various groups. In his survey he found some health education, recognizable as such, to be a part of the UNRWA program. However, the survey also found educationally significant situations, which were neither recognized nor utilized as health education. If health education were to be accepted as an integral part of the Agency's program, it seemed important to try to develop a broader concept of what health education is and what it can do.

It was felt that a written statement, concisely and simply presenting a broader educational approach to health, would be useful to the UNRWA staff, especially to the health, education, and welfare divisions. Such a statement was prepared during the summer of 1952 as a stimulation to continued thought and discussion, as a record of some of the thinking which had taken place in group discussions throughout the camps, and as a guide for future planning.

Believing that this statement, which was prepared for wide distribution among the UNRWA staff, may also be of some general interest to the public health profession, it is presented below with a few editorial changes which seem appropriate in this new setting.

The Statement on Health Education

Good health education aims to help more people make more free-choice decisions which will result in the maintenance or improvement of their health. The state of health of each

individual is basically the result of his own actions; or, putting it another way, our health is what we make it, to the degree that we are at all able to control our private and social condition. Other than small babies, mental defectives, and those incompetent to assume the normal responsibilities of life, there are few persons who are exceptions to this statement. Each of us inherits certain health strengths and weaknesses, sometimes serious health handicaps. Whether we use our inheritance and the environment in which we find ourselves most effectively for the maintenance and promotion of sound health is largely a matter of personal or group choice.

Society usually provides such health protection services as water purification, sewage disposal, food protection, or quarantine services. And even when these services are provided, their effectiveness is still dependent in large measure on individual and group choice of action. One may choose to drink from the pure water supply or from a supply of questionable potability. Clean safe food provided in a store can become contaminated because of bad health habits in the home. Sewage disposal systems must be used properly to be effective. Quarantine laws protect only to the extent that they are obeyed.

On the other hand, where governments have failed to take the necessary action to protect the health of the citizen, each individual can, through personal choice, and without the aid of government, act to protect his own health and that of his neighbor though his choice of action may be limited by the culture within which he exists. Water can be boiled. Foods can be washed, peeled, cooked, protected by refrigeration, and shielded from dust or insect contamination. Human excreta can be disposed of safely. Ill persons can be avoided and simple isolation practiced. Occasionally, individuals may be forced into situations injurious to their health, but even these situations often represent a group choice, which still leaves opportunities to choose a personal course regarding health.

Health Education Defined

The correct choice of action is most frequently made by those of us whose education regarding health is most complete. By education, we mean that aggregate of experience which enables us to live with the highest degree of efficiency, satisfaction, and service in the environment in which we find ourselves. The importance of sound health education is, therefore, obvious.

"Health education is the sum of all experiences which favourably influence habits, attitudes, and knowledge relating to individual, community, and racial health" (*1*), to quote one definition of health education, and "health," as defined by the Constitution of the World Health Organization, is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (*2*).

The health education experiences most frequently referred to are (*a*) the conscious, formalized type of instruction, whether in the school class, university, or community study group, and (*b*) the exposure to one or more of the usual types of mass media. These kinds of experiences are related to the imparting of information and may or may not educate for action. Too frequently they do not. Individuals may become quite well informed about the ways to establish and maintain health, but until they freely choose to act in accordance with such information they are not really "educated" about health.

Many basic health attitudes and practices are developed without conscious instruction. Care of one's body, eating habits, patterns of sleep, care of the teeth, home remedy practices, actions in the face of oncoming illness, attitudes toward health and disease, choice and use of professional health and medical services—these and many other actions that daily affect health are much more the result of the experience of living in close contact with certain cultural patterns and social customs than of specific information acquired, no matter from what source.

It is true that present actions are dictated by past experience, notwithstanding the fact that one may possess information which indicates an entirely different choice of action.

The Bedouin mother who had had the experience of losing two children because, as she thought, they had got their heads wet, chose not to bathe her third child. She made this decision in spite of the information given her by the nurse as to the great benefit to the child of regu-

lar bathing and the careful explanation that wetting the head had not killed the other two children. The experience of daily visiting the baby center and seeing other mothers wetting their children's heads without harm finally convinced her that she should try it too. Another experience had been added to her life which helped her to make another free choice, that of washing her baby.

The word "favourably" in the definition of health education (*1*) is important. Some education in respect to health is unfavorable. Too often the unfavorable education is of the experiential type, and its importance is not recognized. A class may learn from the textbook that good ventilation is necessary for the promotion of sound health. Yet, because of a teacher's choice, this same class may sit daily for several years in a hot, poorly ventilated room. The members of the class may develop a liking for such an unhealthy condition despite the instruction in the book.

Or, a woman is urged to come to a maternity home for delivery. Once there, she is given the best medical and nursing care from a technical standpoint and is delivered of a fine baby. But, at the same time there may be so little human kindness and sympathy associated with the professional services that she "learns" that maternity centers are places to be avoided. The experiences of personal neglect and unhappiness will far outweigh the information concerning the usefulness of maternity centers which she may receive at the next antenatal class, if she attends one.

Experiences continually shape patterns of health habits. These experiences, being frequently repeated and usually touching personal lives closely, tend to outweigh the experiences of didactic teaching and information received from various sources. Those of us in public health have only to consider our own actions regarding health to recognize the truth of this statement.

Most of the experiences which educate positively or negatively for health can be controlled. Those of us who are in public health, in whatever particular professional group, need to train ourselves to recognize these experiences and to attach more importance to planning that the experiences be essentially favorable in effect. In our planning groups we would do well to include, whenever possible, the persons themselves who are to be educated. For it has been said that people usually act upon plans that they have helped to make.

Action is important. To know that vaccination protects against smallpox is to be informed, but to be vaccinated is to be "health educated" with respect to the control of smallpox. Health education, to be effective, must achieve desirable action.

Health Education in UNRWA

In studying health education in UNRWA, we noticed among the professional staff and the refugees themselves a general confusion between health instruction and health education. The aim of health education was most frequently considered to be informing people about health—specific situations which might be called "health instruction," situations in which people were being told what to do—rather than stimulating people to act wisely in regard to their health. The objective was arrived at through the fallacious reasoning that to know is to act.

Health education found throughout the camps was being carried on by many different people in UNRWA. This is as it should be, for health education is, for the most part, an aspect of a program or service rather than a separate entity in itself. It should be carried on by all members of the staff, with the person designated as health educator having the responsibility of stimulating and facilitating the health education aspects of the work of others, as well as of carrying on some direct education.

The program contained many examples of health education and many more opportunities not yet put to use in the interests of health education. Some of the situations found in UNRWA camps more commonly recognized as involving health instruction are these:

Teachers in elementary schools give some health instruction.

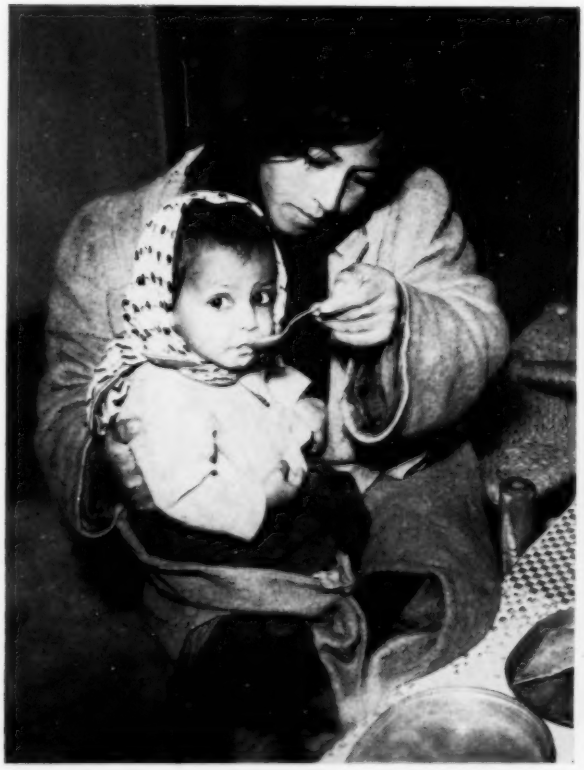
Some sanitary inspectors during their daily work give talks to groups of people, explaining the reasons for sanitary regulations.

Health instruction is a part of the literacy training included in the work of one sewing class.

Positive Education for Health

WHILE as many as 6,000 Palestine Arab refugees are still living under canvas in a refugee camp, most of the camp populations have now been housed in huts of concrete or lumber, which give much better protection against winter storms and hot desert wind. From more than 30,000 tent units in 1950, UNRWA has reduced

the tent housing to approximately 10,000 in 1954. The present number in all UNRWA refugee camps is 340,000. Each camp has a supplementary feeding center, which serves milk and a daily cooked meal to all babies and children recommended by the camp physician. From early pregnancy, mothers are encouraged to attend the antenatal clinics. They learn to make their own baby clothes. They are urged to come to the maternity home for delivery of their child. Once a baby is born, his mother is encouraged to bring him regularly to the infant health clinic. She learns how to bathe her baby. Both mothers and children are having experiences which daily help them to learn the value of good food, carefully prepared and served.



Posters are displayed on the walls of schools, offices, clinics, feeding centers, and similar places.

Some films on health subjects have been shown to school children and to community groups.

Nurses and midwives teach mothers how to wash and dress their babies.

Suggestions for improving health education in UNRWA, made by staff and refugees, included motion picture shows, posters, talks to mothers, additional hours of instruction in schools, use of pamphlets, lectures to young girls, and special classes on health. All of these ways of instructing are important but of little effect if they are not made an integral part of a planned, broad-based education program which includes, in addition, those kinds of personal experiences which influence individuals to action.

The following are a few experiences of those in the camps of UNRWA, which may be having an even deeper effect on the formation of individual health habits but which are not always recognized as having health education significance:

Mothers and children at feeding centers enjoy meals which daily help them to learn the value of good food, carefully prepared and served.

In the feeding centers where young girl volunteers are assisting, good habits are formed with respect to the preparation and care of food.

In some areas it was reported that nurses and midwives were making at least a few visits to their patients' homes, a most effective form of health education.

The experience of being a part of the well-regulated community life of camps and compounds, with available sanitary services, pure water supplies, clinic services, feeding and recreation centers, and reading rooms may be the most important single factor responsible for changing for the better the health habits of the refugees.

The observable good effects of early diagnosis and treatment, of immunization and professional medical care, in reducing or entirely preventing illness, are a potent educational experience.

Hospitalization, when it is a satisfying experience, increases respect for health practices.

In one feeding center, sick mothers and babies, by being placed in isolation, learned to attach importance to the communicability of disease and to the practice of simple isolation.

Profitable and healthy use of leisure time was learned at welfare centers where games are available.

Other examples of health education were found in UNRWA camps, but an extension of the list would serve no useful purpose here. The amount and quality of the health education found were, to a large degree, proportionate to the interest and conviction and capacity of the professional worker responsible. Although there were some who were notable exceptions, many members of the professional field staff of the health division seemed to hold the opinion that medical service—the treatment of disease—was of first importance and that since caseloads and the scarcity of equipment and supplies made it almost impossible to meet demands in this area, it was useless to attempt health education. Health education they considered to be an extra duty, not seeming to understand that through effective health education a crushing caseload might eventually be lightened.

Another attitude which must be considered in these particular health education activities is the refugee's conviction that under present living conditions he can do nothing to protect or improve his health. To the question, how can we help the refugee improve his health? the answer was repeatedly: Supply him with more and better food, a better house, more clothes, and he will take proper care of his health; he knows how but is prevented from doing so because of his living conditions.

Since even the most highly developed and health-educated people still need further health education because they do not always act for their own best interests, it seems improbable that the refugee would become sufficiently health-educated simply by being given clothes, a better home, and better food. In fact, in this part of the world a look at any group which is not composed of refugees refutes the argument. That these people can learn to change health habits for the better has been demonstrated.

Many refugees in only these few years have

changed lifelong habits. Many a desert dweller who had never before used latrines now uses them.

Many a refugee who never gave a thought to his water supply now chooses to use the safe supply provided for him.

Many a mother is washing and dressing her baby in a more satisfactory manner and is submitting her children to immunization, a procedure to which she objected vigorously a few years ago.

People—all kinds of people—can be helped to learn how to make good choices respecting their health. The first step is to help them want to make the change.

Program Development and Planning

The creation of trained leadership is the first need for the further development of health education on a wider basis among the Palestine refugees. Once there is trained leadership, the priority steps in developing the type of health education defined in the foregoing might take the form of the following suggestions:

1. Assist the UNRWA staff to make use of existing opportunities for health education as these are recognized and help the staff stimulate and create new situations where necessary so that refugees will have more opportunities to acquire positive health habits.
2. Assist in the training of additional leadership in health education of the public.
3. Develop, with the assistance of the Palestine Arab refugees, a broad, planned program of health education which can serve as a foundation for the continuation of health education services wherever the refugees may eventually live.
4. Develop an apprenticeship program whereby the kinds of effective health education now being carried on by some staff members can be learned by others.
5. Assist in obtaining or developing simple health education materials, to be tested for effectiveness before being given wide distribution.

Before a year passed the United Nations Relief and Works Agency for Palestine Refugees had started acting on these suggestions for future planning. The Agency entered into negotiations with the World Health Organization for specific assistance in developing the health education program. The two organizations signed an agreement in August 1953 whereby, under the United Nations expanded program of technical assistance, the World Health Organization would assign a qualified public health educator to the Agency, would underwrite training fellowships in health education for 10 persons, and would provide a modest sum for teaching equipment and materials.

In November 1953 the World Health Organization assigned a public health educator to UNRWA on a 2-year contract. Through his coordination with members of the UNRWA staff and the staffs of other agencies, a course of instruction in health education was established at the Agency headquarters office in Beirut. The course consists of 6 months of academic work, which is integrated with some field work, and 6 months of full-time supervised field training. Ten Palestine refugees, 7 men and 3 women, were recruited for the training from the areas served by UNRWA and reported on February 22, 1954. The 9 members of the class who completed their academic work in August 1954 and their supervised field work in February 1955 have been employed on a full-time basis by the Agency and are working in the 4 countries in which they did field work.

Thus far the training course has been successful. The Agency requested an increase in fellowship funds, which WHO granted, to assist in the support of a second class of 11 persons who commenced their academic work in November 1954. This group is now on supervised field work in Lebanon, Syria, Jordan, and Gaza. They will complete the year's course in October 1955, at which time it is anticipated they will also be employed by the Agency. It is hoped that eventually they will be utilized as health education leaders by governments and voluntary agencies in the eastern Mediterranean area.

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A section (pp. 8–14) in the 1955 annual edition of the publication, Health Educators at Work, has been devoted to program planning in health education for the Palestine Arab refugee. Written by Dr. Louis Findlay and William A. Darity, the article tells what came after Mr. Butterworth's article and describes the actual

training program in health education. Dr. Findlay is the WHO medical officer assigned to UNRWA as chief of the health division, Beirut headquarters office, and Mr. Darity is the WHO health educator on loan to the same office. Health Educators at Work is published by the Department of Public Health Education, School of Public Health, University of North Carolina, Chapel Hill, and the Department of Public Health Education, North Carolina College, Durham.

REFERENCES

(1) American Public Health Association: Report of the Committee, Health Education Section. New York, The Association, 1934.

(2) Constitution of the World Health Organization. Pub. Health Rep. 61: 1259–1279, Aug. 20, 1946.

PHS film

Functioning of Gas Feed Chlorinators

Part 1: Visible Vacuum Chlorinator.

Part 2: Volume Metering Chlorinator.

35 mm. Filmstrips, color graphics, Part 1—12 minutes, 57 frames; Part 2—10 minutes, 42 frames. 1954.

Audience: Sanitary engineers, sanitarians, and others interested in water chlorination.

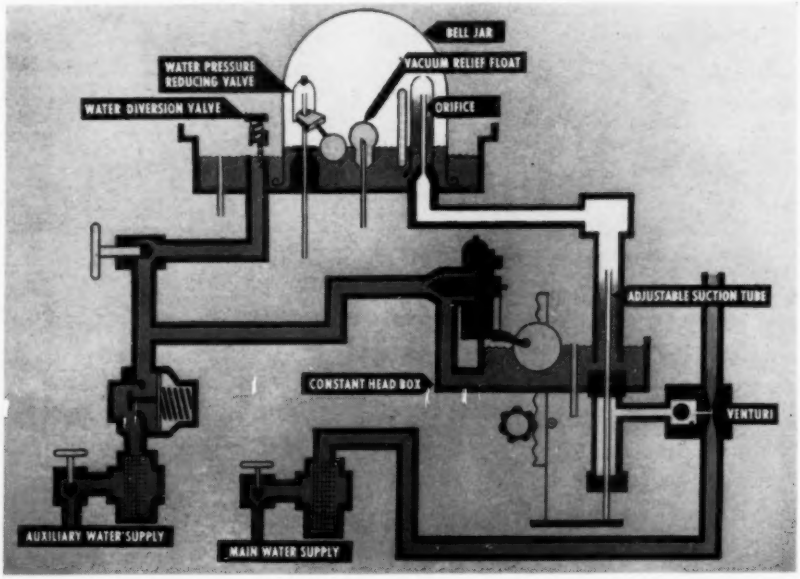
Available: Loan—Public Health Service, Communicable Disease Center, 50 7th St., NE, Atlanta 23, Ga. Purchase—United World Films, Inc., 1445 Park Avenue, New York 29, N. Y.

The primary parts of visible vacuum and volume metering chlorinators and their functions are illustrated in these filmstrips.

Points to be checked at each inspection for assurance of proper operation of the machines are also depicted. For the visible vacuum chlorinator in part 1, the scale inside the bell jar that indicates the amount of chlorine being fed, the weight of the chlorine cylinder to tell how near it is to being empty, the chlorine gas, water supply, and auxiliary supply pressure gauges are shown as operation check-points.

For the volume metering chlorinator, part 2, the water pressure gauge, the pulsations-per-minute, the chart for checking the amount of chlorine fed per day, and the weight of the chlorine cylinder are emphasized.

The basic principles and inspection check-points pictured in these filmstrips aid in the understanding of the functioning of the general types of the machines featured.



A cross section of a visible vacuum chlorinator. Its function is to apply chlorine gas to water in an accurate and continuous flow.

Education of Public Health Workers

By EDWARD M. COHART, M.D., WILLIAM R. WILLARD, M.D., and FRANCES KORD, M.S.

HOW much formal education have public health workers had? How much training in public health have they had? In what fields have public health workers received major education? What further education do they want?

The Yale Public Health Personnel Research Project sought answers to these questions, in keeping with its mission to study people, rather than operations, in public health. Answers were obtained through interviews with 875 professional and semiprofessional public health workers in the State health departments of Colorado, Connecticut, Florida, Maryland, and Michigan, and in selected local health departments and visiting nurse associations in these States and New York. (An account of the methods used was given in the May issue of this journal, pp. 447–452.) These workers were distributed among the various public health services and classified according to position in the administrative hierarchy as shown in table 1.

The agencies chosen for this study were selected, on the basis of the value judgments of the consultants and advisers to the Yale project, as representative of "better-than-average" health departments. Every public health worker whose activities differed materially from those of any of his co-workers was interviewed. As a result, the proportion of high-echelon personnel interviewed was much larger than the proportion of staff-level personnel. This bias may affect conclusions drawn for the combined group of high-echelon and staff personnel and comparisons between them.

Dr. Cohart, associate professor of public health, Yale University School of Medicine, and Dr. Willard, dean of the College of Medicine at Syracuse, State University of New York, were co-directors of the Yale Public Health Personnel Research Project. Miss Kord, director of health education for the Massachusetts Tuberculosis and Health League since 1953, was a research assistant with the Yale project. *The project was supported by research grants from the National Institutes of Health, Public Health Service, and the National Tuberculosis Association.*

Level of Education

Only 5 percent of the personnel at the higher administrative levels (those of supervisor and higher rank) and 13 percent at staff level had not gone beyond high school (table 2). About 40 percent of the personnel in the statistics service, at both staff and higher administrative levels, as well as 27 percent of the sanitation personnel at staff level and 20 percent of the administration personnel in the high echelons, were in this category.

Thirteen percent of the high-echelon personnel and 32 percent of staff-level personnel had 1 to 4 years of college education but had not received a degree. Whereas 80 percent or more of the high-echelon personnel in most of the services were college graduates, only 40 percent of administration personnel and 47 percent of statistics personnel were in this class. Fifty-five percent of all staff-level personnel were college graduates; the nursing service had the lowest proportion, with 32 percent.

Fifty-three percent of all high-echelon per-

Table 1. Number of personnel interviewed in official agencies and visiting nurse associations, by administrative level and service

Service	High-echelon [1]	Staff [2]	Total
Medical	99	13	112
Nursing	118	[3] 142	260
Sanitation	69	117	186
Veterinary [4]	4	7	11
Laboratory	38	87	125
Dental	6	6	12
Administration	30	3	33
Health education	10	20	30
Statistics	17	23	40
Nutrition	12	1	13
Social work	8	6	14
Other professional	14	25	39
Total	425	450	875

[1] Includes persons with titles of supervisor, consultant, administrative assistant, assistant program director, program director, assistant health officer, and health officer.

[2] Includes persons classified as staff and senior staff.

[3] Includes 1 practical nurse who is counted with "other professional" personnel in subsequent tables and analysis.

[4] Unless otherwise stated, veterinarians are included with sanitation personnel in subsequent tables and analysis.

sonnel held master's or doctor's degrees. Even when the medical service is excluded, the proportion is still slightly higher than 40 percent. Graduate degrees were least common among statistics and administration personel. Among staff-level personnel, only 22 percent possessed master's or doctor's degrees. Aside from the medical service, the health education service had the highest proportion of personnel with such degrees.

In general, except for the medical service where the doctoral degree is the rule, graduate education was found to be positively associated with position in the administrative hierarchy. Meaningful comparison could be made only in some of the larger services, such as nursing, sanitation, and laboratory.

In the nursing service, 36 percent of the program directors and consultants, as compared with 10 percent of the supervisors and 3 percent of the staff personnel, had graduate degrees. Among sanitation personnel, 53 percent of the program directors, 17 percent of the consultants and supervisors, and 22 percent of the staff workers had graduate degrees. Among the laboratory personnel, 66 percent of the high-echelon personnel, 41 percent of the senior staff, and 17 percent of the junior staff held graduate degrees. The laboratory service presented a different pattern from the other two services in that the level of education of senior staff personnel differed materially from that of junior staff personnel.

Because of the marked salary differentials among the several services, the relation of salary to level of education was analyzed for each of the larger services separately. In the medical service, no association could be shown between educational level and salary since all members had doctoral degrees, but in the other services analyzed, a positive association was found.

Six percent of the nurses earning less than $4,000 and 30 percent of those earning $4,000 or more had graduate degrees; 40 percent of those earning less than $4,000 and 75 percent of those earning $4,000 or more were college graduates.

Among sanitation personnel with salaries of $4,000 or higher, almost half had graduate degrees, whereas only 5 percent of those earning less than $4,000 a year had achieved this level of education. One-third of the sanitation personnel earning less than $4,000 and 85 percent of those in the higher salary brackets were college graduates. Half of the engineers and 6 percent of the sanitarians with graduate degrees held positions which paid $6,000 or more.

More than half of the laboratory personnel in the $4,000-and-higher salary brackets and only 6 percent of those earning less than $4,000 held graduate degrees. It was rare for a laboratory worker without at least an undergraduate degree to earn $4,000 or more. Only 3 percent of the laboratory personnel earning $4,000 or more were not college graduates. In the salary brackets below $4,000, 40 percent of the personnel were not college graduates.

Level of Public Health Training

Public health training was classified into formal and informal. Included in formal training were graduate degrees in public health, baccalaureate majors or minors in public health, and certificates in public health nursing. Planned inservice training (but not orientation as part

of supervision), institutes, short courses, field training, and the study of public health in the basic training of nurses were considered informal public health training.

One-quarter of the high-echelon personnel held graduate degrees in public health; one-fifth had had undergraduate training in the nature of a major or minor in public health or a certificate in public health nursing; and one-third had received informal public health training only (table 3). More than half of the high-echelon medical personnel and an even higher proportion of the high-echelon nurses had had formal public health training, but most of the nurses had received their training at the undergraduate level. Undergraduate public health training of personnel other than nurses was negligible.

Only 7 percent of the staff personnel held graduate degrees in public health, and only 14 percent had had formal public health training at the undergraduate level. Among staff personnel, as among high-echelon personnel, undergraduate training in public health was restricted almost entirely to nurses. A trend toward the more widespread inclusion of instruction in public health in the basic training of nurses is indicated by the fact that 65 percent of the nurses who had received their training since 1930 had had such instruction, as compared to 45 percent prior to that date.

Approximately half of the staff-level personnel in the medical, nursing, and health education services had received formal public health training, as compared with 4 to 12 percent of the personnel in the other professional services.

In view of the high educational level of many members of the laboratory service, but the relative paucity of public health training, the areas of graduate study of laboratory personnel were investigated. This information was available for 36 laboratory personnel: 86 percent had specialized in the natural sciences; 14 percent, in public health; 8 percent, in medicine; 5 percent,

Table 2. Level of education of personnel in State and local health departments [1]

Administrative level and service	Number of personnel	Percent with—				
		High school diploma or less	1–4 years' undergraduate education	Bachelor's degree	Master's degree	Doctor's degree
High-echelon						
Medical	99	0	0	0	0	100
Nursing	118	0	22	52	24	1
Sanitation	73	7	14	36	37	7
Laboratory	38	0	8	26	32	34
Statistics	17	41	12	29	6	12
Nutrition	12	0	0	25	75	0
Administration	30	20	40	30	10	0
Other professional	38	8	8	21	47	16
Total	425	5	13	29	23	30
Staff						
Medical	13	0	0	0	0	100
Nursing	141	0	68	29	3	0
Sanitation	124	27	18	31	17	6
Laboratory	87	11	8	57	18	5
Statistics	23	43	9	22	22	4
Health education	20	0	20	25	55	0
Other professional	[2] 41	10	36	17	24	14
Total [3]	449	13	32	33	15	7

[1] Includes visiting nurse associations.
[2] Information on level of education was not obtained from one staff worker.
[3] Total percentages are approximations only, because the staff-level interview sample was not equally representative of all services.

Table 3. Level of public health training of personnel in State and local health departments [1]

Administrative level and service	Number supplying information	Percent with—				
		No training	Informal training only	Formal training		
				Undergraduate education [2]	Graduate degree, nonaccredited	Graduate degree, accredited [3]
High-echelon						
Medical	67	25	18	1	3	52
Nursing	85	0	22	66	5	7
Sanitation	41	20	60	0	3	17
Laboratory	28	28	65	0	0	7
Statistics	10	40	50	0	0	10
Nutrition	12	17	42	0	25	17
Administration	15	87	7	0	0	7
Other professional	35	28	37	6	2	26
Total	293	21	33	20	4	22
Staff						
Medical	12	17	25	0	0	58
Nursing	92	4	51	44	0	0
Sanitation	71	25	62	8	3	1
Laboratory	85	50	46	0	0	4
Statistics	21	43	52	0	0	5
Health education	14	43	0	0	7	50
Other professional	34	44	47	3	0	6
Total [4]	329	29	49	14	1	6

[1] Includes visiting nurse associations.
[2] Baccalaureate major or minor or certificate in public health nursing.
[3] Schools accredited by the American Public Health Association for degrees in public health.
[4] Total percentages are approximations only, because the staff-level interview sample was not equally representative of all services.

in engineering; and 3 percent, in veterinary medicine.

All the graduates of accredited schools of public health were given the opportunity to discuss the training which they had received, and 80 of them offered comments. It is important to point out some of the characteristics of this group before considering the replies. Approximately half had received their public health degrees since 1945, and only 15 percent, prior to 1935. Professionally, the group was constituted as follows: physicians, 52 percent; health educators, 11 percent; nurses, 9 percent; engineers and laboratory scientists, each 6 percent; dentists, 5 percent; sanitarians, 4 percent; statistics and nutrition personnel, each 2 percent; and administrators, 1 percent.

The most frequent criticism of the public health curriculum was to the effect that not enough instruction was given in the practical aspects of community organization and public relations. This was closely followed in frequency by statements about the lack of adequate courses in administration. Through many of the comments ran the complaint, either implied or clearly stated, that the graduate curriculum in public health was not practical enough, that it should place much more emphasis on field work, and that perhaps many of the teachers might benefit from current, or at least more recent, practical experience in the field.

Table 3 reveals that one-third of all high-echelon personnel had had only informal public health training. An additional one-third had received such training as well as formal public health training. As can be seen in table 4, informal training was most frequent among nursing personnel and practically nonexistent for administration personnel.

An analysis of the type of informal training

received reveals that, in every service, there was greater participation in short courses or institutes than in any other category of informal public health training. Of all high-echelon personnel, 53 percent had participated in short courses or institutes and 34 percent in field training in other agencies. The extent of participation in field training in other agencies by nurses was at least twice that of any of the other services. Inservice training was the least frequent of the three components of informal public health training.

Two-thirds of the workers at staff level also had received informal public health training, either alone or in combination with formal education in public health. Forty percent had had short courses or institutes; 24 percent had had field training in another agency; and 22 percent had had inservice training.

Staff nurses, like high-echelon nurses, had participated in informal public health training to a greater extent than members of any of the other services. About 90 percent of the nurses had had some kind of informal training in public health, and 72 percent had participated in short courses or institutes.

Content of Education

The content of major education, that is, "minors" or "majors" at the undergraduate or graduate level, was classified according to nine broad categories as follows: mathematics and the natural sciences, medicine, fields allied to medicine, engineering, public health, social sciences, administration, the humanities, and others. The distribution of public health workers according to this system of classification of major education is given in table 5.

The public health workers in this study can be divided into two groups in accordance with the proportions who had had major education in the natural sciences. In one group are the medical, sanitarian, and laboratory scientist personnel, at least two-thirds of whom have had major education in the natural sciences. The

Table 4. Types of informal public health training of personnel in State and local health departments [1]

Administrative level and service	Number supplying information	Percent with—			
		Any informal training	Inservice training	Short courses	Field training in other agencies
High-echelon					
Medical	67	58	9	39	30
Nursing	85	95	16	73	64
Sanitation	41	80	22	49	19
Laboratory	28	71	25	46	25
Statistics	10	50	20	40	0
Nutrition	12	75	42	58	33
Administration	15	7	0	7	0
Other professional	32	53	18	68	16
Total	290	71	17	53	34
Staff					
Medical	12	66	25	58	50
Nursing	92	90	17	72	47
Sanitation	71	69	39	42	20
Laboratory	85	54	15	10	5
Statistics	21	57	24	48	4
Health education	14	50	7	28	36
Other professional	35	60	20	22	11
Total [2]	330	68	22	40	24

[1] Includes visiting nurse associations.
[2] Total percentages are approximations only, because the staff-level interview sample was not equally representative of all services.

Table 5. Content of major education of public health personnel

Category of personnel	Number supplying information	Percent with major education in—								
		Mathematics or the natural sciences	Medicine	Fields allied to medicine	Engineering	Public health	Social sciences	Administration	Humanities	Other
Medical	79	68	100	0	0	58	2	0	9	5
Nursing	177	2	3	100	0	61	3	0	9	7
Engineer	42	5	0	0	100	14	0	2	0	5
Sanitarian [1]	30	70	0	3	3	23	7	3	10	17
Sanitary inspector	30	10	0	3	0	3	3	0	3	10
Laboratory scientist [1]	93	91	8	6	6	4	1	0	8	8
Laboratory technician	20	30	0	0	0	0	0	0	0	20
Statistics	31	16	0	0	3	10	26	10	6	16
Health education	22	36	0	4	0	45	14	0	32	32
Nutrition	13	0	0	77	0	46	0	8	0	62
Administration	18	6	0	0	6	6	6	28	11	28
Other professional	59	19	7	47	3	17	12	10	17	20

[1] College or professional school graduate.

second group embraces all the remaining categories of personnel, only one-third or less of whom have had such education.

Medical education was limited almost entirely to the medical service. All the nurses and a large percentage of the nutritionists, of course, had had major education in allied medical fields. Except for an occasional person with engineering training in the administration, statistics, and laboratory services, engineers were limited to the sanitation service.

More than half of the medical and nursing personnel had had formal public health training. They ranked highest in this respect, whereas sanitation, laboratory, statistics, and administration personnel were at the bottom of a rank-order listing.

With the exception of 14 percent of the personnel in the health education service and 26 percent of those in the statistics service, less than 10 percent of the personnel had had major education in the social sciences. The social science education of the statistics personnel was primarily in the field of economics.

Less than one-third of the administration personnel had had major education in administration. None of the physicians, nurses, laboratory personnel, or sanitary inspectors and only 2 to 3 percent of the sanitarians and engineers had had major education in general administration.

One-third or less of the several categories of public health personnel had had major education in the humanities; health education personnel had the highest percentage with major education in these fields.

Because of the prevailing interest in the baccalaureate majors of medical personnel who enter upon careers in public health, this subject was investigated. Eighty-two percent of the physicians had majored in the natural sciences, and 9 percent, in the humanities. The remaining 9 percent were spread among several different fields, with only 1 percent in the social sciences. It is evident, therefore, that education in social sciences could not have been a major factor in directing the paths of these individuals into public health.

Another area in which there has been considerable interest is the baccalaureate majors of health education personnel. The findings in this study corroborate the general impression that health education personnel have diverse educational backgrounds. One-third had majored in the humanities; another third, in the natural sciences; and only 11 percent, in the social sciences. In the group of health educators with graduate degrees from accredited schools of public health, almost half had majored in the natural sciences, but none had majored in the social sciences.

Desire for Additional Education

Approximately 70 percent of 608 professional public health workers (in Connecticut, Maryland, Michigan, and New York) desired additional education (table 6). Differences between State and local personnel were not significant, and the desire for further education was not related to position in the administrative hierarchy. Fewer medical than nursing, sanitation, or laboratory personnel wanted additional education.

Sixty-eight percent of the workers desiring further education wanted individual courses not leading to a degree; 1 percent wanted a baccalaureate degree in engineering; and between 6 and 10 percent desired each of the following types of education: inservice training, institutes, a baccalaureate degree in a field other than engineering, a graduate degree in public health, and other graduate degrees. A significantly higher proportion of high-echelon nurses (20 percent) than of other high-echelon personnel (4 percent) desired a graduate degree from a school other than an accredited school of public health, and a significantly higher percentage of the staff nurses (30 percent) than of other staff personnel (4 percent) desired a baccalaureate degree.

As a further index of the emphasis placed upon education by different categories of public health personnel, the data were analyzed to determine how many of those without degrees desired them. The numbers without college degrees in the higher levels of the administrative hierarchy were too small for meaningful comparison by service. At the staff-level, 34 percent of the nurses, 23 percent of the laboratory personnel, and 10 percent of the sanitation workers not holding degrees desired them. A significantly higher proportion of nurses than of all other personnel combined desired a baccalaureate degree.

Table 6. Content of education desired by personnel of State and local health departments [1]

Administrative level and service	Number supplying information	Percent desiring further education	Percent desiring education in—			
			Public health	Mathematics or the natural sciences	Social studies [2]	Humanities
High-echelon						
Medical	66	56	39	11	23	0
Nursing	84	82	53	5	25	11
Sanitation	40	80	57	25	28	0
Laboratory	28	68	21	42	4	4
Statistics	10	70	30	30	20	0
Nutrition	12	92	67	8	33	8
Administration	15	60	27	7	33	0
Other professional	30	67	43	10	27	3
Total	285	72	45	14	24	4
Staff						
Medical	12	50	33	8	8	0
Nursing	89	79	66	0	16	6
Sanitation	69	71	57	17	21	0
Laboratory	84	70	20	54	6	0
Statistics	21	52	14	29	9	5
Health education	12	58	0	0	58	0
Other professional	36	58	33	3	25	6
Total [3]	323	69	42	20	16	2

[1] In Connecticut, Maryland, Michigan, and New York.
[2] Includes the social sciences, the science of human behavior, administration, community organization, and the arts and techniques of communication.
[3] Total percentages are approximations only, because the staff-level interview sample was not equally representative of all services.

Education desired was divided into four broad categories: public health, mathematics and the natural sciences, social studies, and the humanities. Social studies included the social sciences, the science of human behavior, administration, community organization, and the arts and techniques of communication. The preferences of the members of the several services in accordance with administrative level are to be found in table 6.

Of all the public health personnel interviewed, approximately one-half desired further education in public health; one-fifth, in social studies; one-sixth, in mathematics and the natural sciences; and only a small fraction, in the humanities. A significantly larger proportion of the high-echelon personnel (24 percent) than of the staff personnel (16 percent) desired further education in social studies.

There were a number of significant differences among the services. Fewer laboratory personnel than any other category, except statistics and health education personnel at staff level, desired further education in public health. A much larger percentage of laboratory personnel than of personnel in any other service were interested in further education in the natural sciences, and, correspondingly, a much smaller percentage of laboratory personnel wanted further education in social studies.

A more detailed examination of the desire for further education in public health revealed that the greatest demand among high-echelon personnel was for general public health education. Fifteen percent indicated this preference. Five percent wanted education in environmental sanitation; 5 percent, in medicine; and 3 percent, in engineering. Two percent or less expressed the desire for education in adult health, communicable disease, health education, laboratory science, maternal and child health, medical care, mental health, nursing, or rehabilitation.

Among staff-level personnel, 11 percent desired education in nursing; 9 percent, in environmental sanitation; and 4 percent, in engineering. Seven percent of the staff workers were interested in general public health education. Two percent or less expressed a preference for education dealing with any of the other aspects of public health.

Areas for Evaluation

Although the purpose of the research reported here was simply to determine the facts, it would seem appropriate to point out a few of the areas in which the factual data call for evaluation.

There was a wide range in educational level. Approximately one-tenth of the professional and semiprofessional personnel had not gone beyond high school. Another one-quarter had not received a college degree. Nurses are in an unusual position in this respect, inasmuch as most nurses obtain their training in hospital schools of nursing, which do not grant degrees.

Do these findings indicate that a sizable proportion of the workers have not reached an educational level sufficient to qualify them for their jobs? If the answer to this question is in the affirmative, what are the factors responsible for this state of affairs and how can they be altered?

Or are there forces operating within the domain of public health which place unwarranted emphasis on educational level and therefore lead to the pursuit of academic degrees which do not necessarily contribute to the successful fulfillment of public health job responsibilities? Why, for example, do public health nurses feel a strong need to obtain a baccalaureate degree? Is it because they feel the need for more education in the liberal arts, the social sciences, or the techniques of nursing? Or is it because the possession of a college degree, regardless of area of study, is necessary for advancement?

Undergraduate training in public health was relatively frequent among the nurses and practically nonexistent among the other categories of personnel. Are opportunities for undergraduate education in public health being missed? Or should education in public health be reserved for the graduate level?

Laboratory personnel differ from most other health department personnel in that their interests appear to be restricted to the laboratory and do not encompass the broad field of public health practice. What effect does this have on the "team approach?" For that matter, what is the effect of marked variation in educational level and background upon communication, administration, and a cooperative effort? Does

the common understanding essential for teamwork exist?

A positive correlation was shown to exist between formal education and position in the administrative hierarchy and between education and salary, but exceptions were sufficiently frequent to give one pause. Are these exceptions examples of poor public health practice? Or is formal education perhaps less important than public health workers are in the habit of believing?

It was reported in a previous article that about one-third of the time of health workers was devoted to activities related to administration and community organization. How have public health workers been qualified by education to perform these tasks? Major education in administration was rare indeed, except among personnel in the administration service, and even there it was found among a minority only. Major education in the social sciences, although not as rare as that in administration, was limited to less than 1 in 10 workers. Emphasis was on the natural sciences. Is this adequate preparation for public health practice? Perhaps we have placed too much emphasis on level of education and given insufficient consideration to content.

The importance and value of public health training need reexamination in the light of several of the findings of this study. Between one-fifth and one-third of the public health workers had had neither formal nor informal public health training, and another third had had informal training only. Formal public health training was more frequent among high-echelon than among staff-level personnel and very much more frequent among the physicians, nurses, and health educators than among other personnel. How do these facts influence public health practice? And, conversely, what is the effect of public health practice on public health training?

Only a relatively small proportion of the personnel desired inservice training. An investigation into the reasons for this attitude might be revealing. It is not unlikely that the nature and caliber of inservice training programs were important determinants of this attitude and that the proper organization of inservice training presents a major opportunity for the education of public health workers. Where does responsibility for such organization rest?

What is the role of the schools of public health in the education of public health workers? It appears that the schools of public health play a major role in the education of medical personnel only. More than 50 percent of the public health physicians and health education personnel had received graduate education in public health, but only about 10 percent of the members of the other services had had such education, many of them in schools other than the accredited schools of public health. Furthermore, informal public health education in the form of short courses and institutes was the greatest single source of public health training for the latter workers and also the type of training desired by the largest number. Schools of public health play a very minor role in sponsoring and giving such courses.

The most frequent criticism of the curriculum of schools of public health was related to the teaching of administration and community organization. A common complaint was that this training was not only insufficient in amount, but also inadequate in scope, because of the failure to include practical applications of principles, in line with the needs of practitioners of public health.

The problem raised by this criticism is part of a broader question which relates to the role of institutions of higher learning generally. Is it the responsibility of such institutions to train investigators and research workers who will enlarge the boundaries of knowledge? Or is it their responsibility to train practitioners to apply present knowledge effectively to the problems of our society? Or is it perhaps both of these? If the responsibility does, in fact, encompass the training of both researcher and practitioner, then it appears that it is not being discharged adequately by our schools of public health.

Morbidity and Mortality in Early Infancy

Infant mortality in the United States, as evidenced by records available since the organization of the birth registration area in 1915, has declined rather steadily. The rates in the Mountain and Southern States are somewhat higher than in the three other broad regions—the Northeast, North Central, and Pacific sections.

Trends of infant mortality of males and females are parallel but the rates for females are considerably lower than those for males. Considering actual rates by age of the infant, the older the infant the more rapid the percentage decline in infant death rates.

Reduction of rates to a comparable annual basis indicates extremely high mortality from all causes at the ages under 1 day and 1–2 days, with an uninterrupted decline with age in the rates for the 12 months of the first year of life.

Among infants of all ages under 1 year, the most frequent causes of illness are respiratory, digestive, communicable, and congenital malformations and diseases of early infancy. In contrast, the most frequent causes of death are immaturity, both with and without various diseases of early infancy, and congenital malformations. Pneumonia also stands high as a cause of infant mortality.

In five broad diagnosis groups for illness and mortality, infant illness rates for females are generally below those for males, and infant mortality rates for females are almost uniformly lower than for males.

Considering an immature infant as one weighing 2,500 gm. or less at birth, and a mature infant as one weighing 2,501 gm. or more at birth, the neonatal infant mortality from all causes and from specific causes among the mature as compared with the immature was extremely small. However, neonatal mortality among infants weighing 4,501 gm. or more at birth was somewhat higher than at the minimum, which occurred among infants weighing 3,501–4,000 gm.

Whooping cough, measles, and chickenpox had relatively high incidence rates during the first year of life, and mumps and german measles, rather low rates in that period. Whooping cough and chickenpox had relatively high secondary attack rates but measles, german measles, and mumps had relatively low such rates.

Public Health

MONOGRAPH

No. 31

The accompanying summary covers the principal findings presented in Public Health Monograph No. 31, published concurrently with this issue of Public Health Reports. The authors are with the Division of Public Health Methods, Public Health Service.

Readers wishing the data in full may purchase copies of the monograph from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. A limited number of free copies are available to official agencies and others directly concerned on specific request to the Public Inquiries Branch of the Public Health Service. Copies will be found also in the libraries of professional schools and of the major universities and in selected public libraries.

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Collins, Selwyn D., Trantham, Katharine S., and Lehmann, Josephine L.: Illness and mortality among infants in the first year of life. Public Health Monograph No. 31 (Public Health Service Publication No. 449). 20 pages. Illustrated. U. S. Government Printing Office, Washington, D. C., 1955. Price 15 cents.

Cancer Control Activities
of the
National Cancer Institute

By RAYMOND F. KAISER, M.D.

CANCER CONTROL is concerned with the actual prevention of cancer whenever possible, with the discovery of the disease in its earliest stage, and with the provision of adequate services and facilities for diagnosis and treatment. Ideally, a cancer control program to be effective requires:

1. An alert and trained profession.
2. An informed public.
3. Suitable methods for prevention of the disease.
4. Case finding, screening, or diagnostic procedures which can be applied on a mass basis to sort out individuals with the disease from the remainder of the population.
5. Adequate services and facilities for diagnosis and treatment.

The cancer control program of the National Cancer Institute of the Public Health Service is designed to meet some of the needs which exist in these requirements and to demonstrate appropriate methods for fulfilling some of these conditions. This program, now in its eighth year, has special implications for practicing physicians.

Cancer diagnosis and treatment frequently call for the services not of a single physician but of a qualified team. However, the cancer patient ordinarily is seen first by a general practitioner, whose diagnostic training and experience often determines the outcome. For this reason, the major emphasis in cancer control is placed on programs designed to aid the physician by improving professional undergraduate, graduate, and postgraduate education and by providing diagnostic and other special services to help the physician be effective.

If the physician is to manage successfully an optimal number of cancer cases, he must bring to his practice an awareness of cancer in all of its diverse manifestations. Obviously, the place to inculcate such an awareness is in the undergraduate school. However, it can be fairly said that until a few years ago most medical school curriculums did not provide an effective and integrated presentation of this important subject.

On the basis of a study of cancer teaching in medical schools made early in 1946, our National Advisory Cancer Council recommended that the National Cancer Institute undertake a program of financial assistance to medical schools to coordinate and improve the teaching of cancer to undergraduates, thereby increasing

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Dr. Kaiser is chief of the Field Investigations and Demonstrations Branch of the National Cancer Institute, Public Health Service. *He presented this paper before the Maryland Medical and Chirurgical Faculty April 28, 1954.*

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the students' awareness of cancer. The program, based on these recommendations, has gained universal acceptance during the 7 years of its operation, and today all approved medical schools are participating in the program.

Each of the 4-year medical schools receives a grant up to $25,000 annually, and each 2-year medical school receives a grant up to $5,000 a year for the broad purpose of correlating and improving its cancer instruction. Within this general purpose the schools have been permitted maximum latitude to develop the type of program which best meets their particular circumstances. We have always felt that the direction of teaching programs must not come from the outside, but must be intramural and autonomous. Our belief has been justified not only by the widespread acceptance of this program, but by the perceptible improvement in cancer teaching.

A parallel program through which grants up to $5,000 annually are made to dental schools for instruction of undergraduate students in the recognition of oral cancer has been in existence for approximately the same period of time. This program is based on the fact that a large proportion of oral cancer cases are first seen by dentists, and only a limited percentage of these are recognized as malignant conditions requiring immediate referral to adequate medical attention. This program, too, has enjoyed widespread acceptance, and practically all approved dental schools are participating.

In recent years considerable effort has been devoted to the improvement of cancer instruction in a limited number of schools of nursing in order to determine the most practical methods of providing graduates with a better understanding of cancer and to equip them better for handling cancer nursing activities.

For a number of years similar educational grants have been extended to a small number of schools of public health in order to provide instruction for health department personnel in the public health aspects of the cancer problem.

With the increase in the magnitude of the cancer problem, there has developed a need for physicians with special training in the diagnosis and treatment of cancer. Both voluntary and governmental groups provide support for specialized training of graduate physicians. The institute's program enables young graduate physicians interested in cancer to undertake clinical training in specialized fields related to its diagnosis and treatment. In recent years there has been a sharp increase in the number of physicians receiving such training in the three major disciplines of surgery, radiology, and pathology. At present, 143 graduate physicians are being supported in such training throughout the country.

For the practicing physicians, a number of attempts have been made to bring recent information about the disease directly to them. One of the most important of these has been the production, jointly by the institute and the American Cancer Society, of a series of films for professional audiences depicting the early diagnosis of cancer. In this series individual films have dealt with the diagnosis of breast, gastrointestinal, uterine, oral cancer, and lung cancer.

These films have been made available to practitioners through medical societies, medical schools, State health departments, and State divisions and county units of the American Cancer Society.

Other attempts at professional education have been handled through support of national cancer conferences, cancer symposiums, professional bulletins, cancer manuals or guidebooks, and refresher courses. These attempts at professional education have met with varying degrees of success; however, it is an essential part of the cancer problem and is considered a field requiring continuous efforts.

An Informed Public

The history of public understanding of the cancer problem in America has been one of gradual gain in the past century, with a marked increase in public interest and awareness of cancer in recent years. It is conceded by most authorities that a large and continuous education program, based on accurate data and using currently available knowledge, will result in considerable control of mortality from many types of cancer. To be successful, a public education program must stimulate the individual's awareness of cancer and motivate him to seek medical attention at the earliest possible moment in the development of cancer.

To develop an informed public, the institute has created educational materials which complement those of voluntary groups. And it has produced, in conjunction with the American Cancer Society, public information materials. Notable among these has been the film entitled "Breast Self-examination" which presents to women basic facts about breast cancer and urges them to seek their physician's advice at an early date. Another recently released film, "The Warning Shadow," was produced under the same sponsorship and is directed toward men over 45 years of age, urging them to seek semiannual chest X-rays from their physicians.

In addition to assistance in production, the institute has developed arrangements with the American Cancer Society for the use of such information materials in a manner which would stimulate the individual's awareness of cancer and motivate the early seeking of medical care.

In general, the public is better informed about cancer today than at any time in history. However, even with progress in research and therapy, the education problem will continue and, in fact, may increase.

Cancer Prevention

In the field of cancer prevention, knowledge has been meager largely because in the past cancer workers have given little attention to environmental factors which may have a relationship to the causation of human cancer. Much of the knowledge now available has resulted from studies on small groups of people utilizing statistical, genetic, epidemiological, and other techniques to uncover relationships between cancer and environmental factors. For example, the first known etiological agent for scrotal cancer was confined to a small occupational group, the chimney sweeps of London.

Since the inception of the cancer control program, the potentials lying in the field of environmental cancer have been recognized. It was felt that, if relationships could be established between the development of cancer and certain specific materials the individual encounters in his home or industrial environment, it would be possible to eliminate or reduce the exposure to such carcinogenic materials, thereby preventing the development of certain cancers.

Numerous studies and investigations that have an immediate bearing on environmental factors have been undertaken by the National Cancer Institute or have been supported through grants. These studies have shown that most persons, if not all, have some degree of exposure to carcinogenic environmental agents under modern living conditions. They have also shown, however, that there is a latent period before specific cancers appear and that this is related to the degree and duration of exposure to a carcinogenic agent.

While there is much disagreement regarding the exact nature and the role of some of these so-called environmental carcinogenic factors—the current controversy concerning the relationship of cigarette smoking and lung cancer, for one—there has been accumulating in recent years much evidence that cannot be overlooked in respect to cancer control activities.

Among the environmental factors that have been shown to be carcinogenic are (*a*) certain products and byproducts of the manufacture or processing of aniline dyes, coal tars, and petroleum, (*b*) arsenicals and some inorganic chemicals, and (*c*) radioactive substances, X-radiation, and ultraviolet radiation. As more is learned about these and other suspected carcinogenic agents it is feasible to consider the establishment of cancer prevention programs in locations where such hazards exist, incorporating safe production and handling methods for the hazardous materials and instituting periodic examination of the exposed workers.

This is an aspect of the cancer problem which has come under systematic study only recently and in which increased efforts offer unlimited possibilities for making significant contributions to the solution of the cancer problem.

Diagnostic Tests and Case Finding

The key to cancer control today is early diagnosis and treatment, but this statement points up one of our biggest problems—how to find the cancer case early enough. It is recognized that there is no method available today other than general periodic physical examinations which holds promise of discovering early cancer of all types in the population. Periodic examinations do provide the opportunity for discover-

ing a sizable number of early lesions since more than one-half of all cancers occur at sites accessible to direct examination. However, this method is expensive and time consuming; and even if all persons of so-called cancer age could be persuaded to seek periodic examination, there are simply not enough trained hands in the country to do the job. Urgently needed, therefore, is a test which can be applied on a mass basis at reasonable cost and with specificity sufficient enough to identify a high percentage of cancer cases in an early stage.

For a great many years laboratory investigators, as well as practicing physicians, have been looking for differences between persons with early cancer and cancer-free individuals—subtle differences in the blood, sputum, urine, and various body chemicals. The belief that these differences are specific and measurable forms the basis for many reported so-called diagnostic tests. There have been numerous attempts to develop diagnostic and screening tests, and more recently, the entire subject has aroused great public and professional interest. The demand for a diagnostic test has become so great that every new procedure proposed is in danger of premature exploitation before its clinical validity can be determined. Recognizing this situation, the institute, through its Field Investigations and Demonstrations Branch, established a cooperative program with investigators in a number of medical schools. Evaluation of reported cancer tests is carried out under controlled conditions. At the same time, other investigators are encouraged, through grants, to pursue new leads which show promise for the development of a diagnostic or screening test.

Although a general diagnostic test for cancer is not available, some developments in recent years in diagnostic tools may form the basis for a screening test for cancer of specific sites. One of these, the cytological method developed by Papanicolaou and Traut for the discovery of early cervical cancer, has been evaluated and promoted as a diagnostic aid. Its usefulness as a screening procedure for uterine cancer is currently being evaluated by the institute in a study being conducted in Memphis and Shelby County, Tenn., in cooperation with the University of Tennessee Medical School and the county health department. The original cytological technique has been modified for use in the discovery of cancers of other sites, namely, lung, prostate, gastric, and bladder cancer. However, its usefulness and feasibility in these types of cancer have not yet been fully evaluated either as a diagnostic or screening procedure.

A recent promising development in this field is the test for prostatic cancer, developed by Fishman and later modified by Cline. Both of these developments were supported through the institute's control program. Here again further evaluation is necessary and is being carried out by the institute.

Even more recently Penn and Dowdy, with partial support from the control program, have developed a simple blood test which shows some promise of being able to distinguish between people free of cancer and those who may have it. Much more work and evaluation must be carried out on this procedure before it can be declared acceptable.

It might be appropriate at this time to clarify the type of test in which cancer control workers are most interested. Primarily, it is a test which will separate a large group of examinees into two categories—one consisting of those whose reaction to the test is negative, and the other consisting of a relatively smaller number of persons whose reactions are positive and who are, therefore, cancer suspects. It should be a test which would pick up a high percentage of individuals with early localized cancer. It should have a high degree of specificity without a large percentage of either false negative or false positive results. If an acceptable test which meets these general criteria can be developed, it would be a significant forward step in cancer. While such a test would not eliminate the need for further diagnostic procedures to diagnose the case, it would make it possible to concentrate diagnostic efforts on the small group of individuals with positive test results. Despite the many problems associated with the development of an acceptable mass screening test, results to date have been encouraging. It seems entirely possible that a test or battery of tests can be developed which will be effective on a mass screening basis in sorting out cancerous and noncancerous individuals.

In this connection, a small beginning has been made to conduct and support statistical epidemiological studies which might reflect geographic, climatic, racial, socioeconomic, and environmental differences in the occurrence of cancer. Preliminary data from some of these studies suggests that it may be possible to sort out the kinds and types of people who would be most likely to develop cancer. If such determinations could be substantiated, case-finding efforts could be directed more appropriately toward groups with the promise of the greatest cancer yield.

Cancer Facilities and Services

One of the most practical activities which has contributed to the control of cancer to date has been the organization and operation of cancer clinics. These clinics, usually operated in a general hospital, provide an environment in which representatives of the various specialty groups concerned with cancer, such as surgery, pathology, and radiology, can work with the patient's physician in arriving at an accurate diagnosis and effective treatment. The number of cancer clinics in the Nation has increased markedly in recent years. However, there are still not enough to meet the need, and the establishment of additional cancer clinics is being promoted and encouraged. This, along with various other types of services for physicians, has been encouraged through the institute's program of grants to State health agencies for cancer control activities.

Under this program each State receives an annual allotment based on a formula which takes into account cancer mortality, financial need, extent of the problem, and population density. The grants must be matched on a two-for-one basis. These funds may be used for a variety of purposes which aid physicians as well as the cancer patient. Included among these are support for cancer clinics, cytology services, tissue services, cancer registers, statistical research, professional and lay education, nursing services, limited hospitalization for diagnostic purposes, tumor registers, environmental cancer programs, and tissue slide loan registers. All of the official State agencies now have cancer control programs incorporating a few or several of these features.

Conclusion

An extensive, dynamic cancer control program is under way in this country. It has resulted from the combined efforts of many professional groups, private, voluntary, and governmental, as well as from the efforts of medical specialists, clinicians, private practitioners, public health workers, and scientists. There is a continuing need to improve the nature and effectiveness of the program. The latter will improve as cancer research provides more knowledge about the diagnosis, treatment, and prevention of cancer.

idea

X-raying the Heart Cycle

BETHESDA, MD. With the new cardioroentgen actuator, literally a complex trigger for X-ray machines, the taking of X-rays at known times in the heart cycle need no longer be a matter of guesswork.

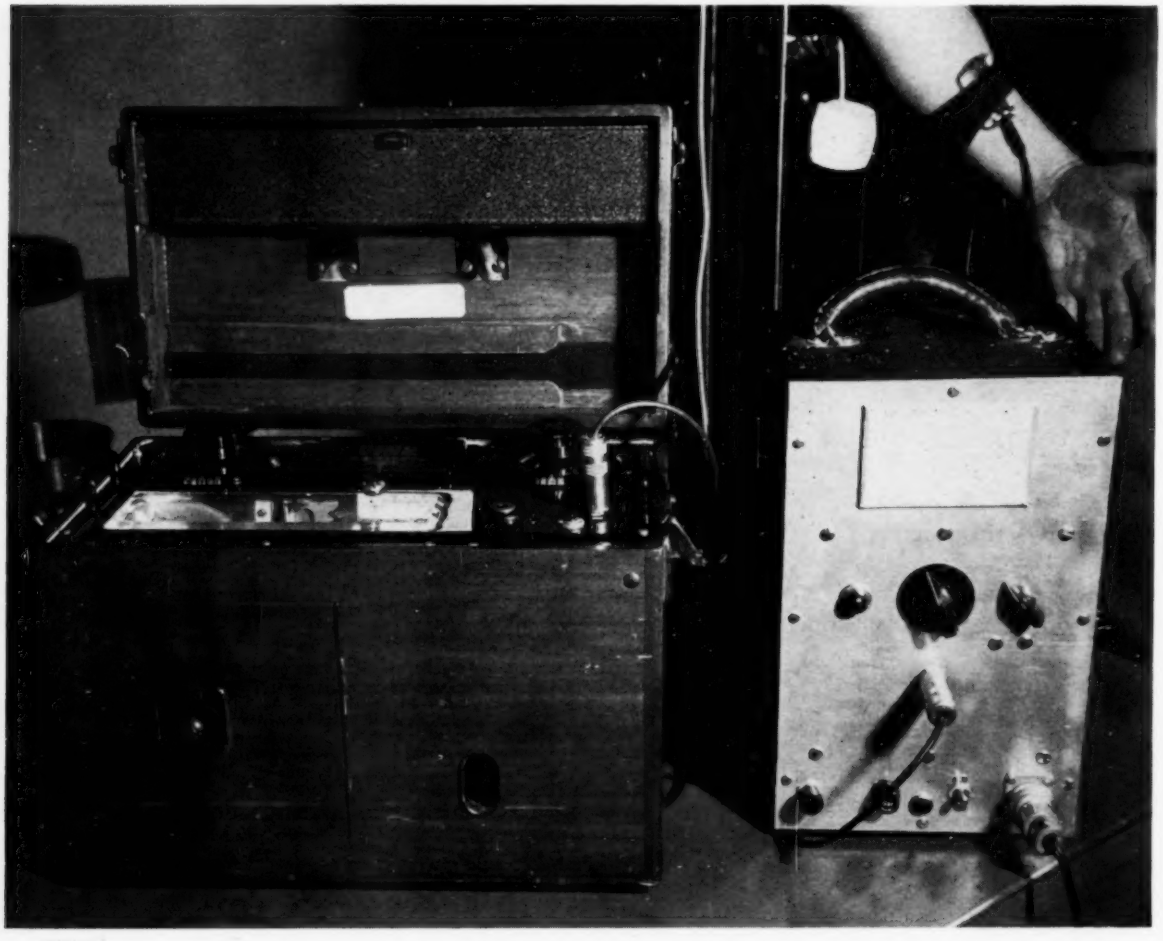
Superior diagnosis and treatment of heart ailments can often hinge on the cardiologist's sure knowledge that each successive X-ray picture to be compared, sometimes taken years apart, was shot at exactly the same instant in the heart cycle. The ever-changing normal heart volumes and the subtle enlargements of sick hearts are variables that frequently deserve precise identification and correlation before two X-ray films can be truly compared.

With the new instrument developed by the Public Health Service at the Laboratory of Technical Development, National Heart Institute, the cardiologist can be assured specific mechanical help in this endeavor.

The photograph illustrates the operation of the instrument. The actuator, housed in a special control box (right) operates in conjunction with a conventional electrocardiograph (left) that continuously traces the heart's electrical activity. This activity is correlated with the expansion and contraction of the heart. The electrocardiographic signal triggers the X-ray exposure at any selected time in the heart cycle.

A monitoring photo cell, hanging below the patient's elbow in the background of the photograph, detects the X-ray exposure and feeds an electrical pulse back into the electrocardiographic curve, marking the exact instant of exposure. A calibrated switch on the actuator permits proper time selection with respect to heart rate so that films can be taken at full expansion, full contraction, or at any intermediate time. In addition, the instrument contains a provision to prevent double exposure.

The actuator is not yet commercially available. A circuit diagram showing the wiring of the instrument and detailed technical information may be obtained from Dr. Bert R. Boone, chief, Laboratory of Technical Development, National Heart Institute, National Institutes of Health, Public Health Service, Bethesda 14, Md.



In preliminary studies, human body lice maintained in the laboratory for many generations on lindane, Lauseto neu, and the pyrethrins developed much less resistance to these insecticides than has been developed to DDT. The lice developed no resistance to a pyrethrum-sulfoxide compound after 30 generations.

Resistance of Human Body Lice to Insecticides

By GAINES W. EDDY, M.S., M. M. COLE, B.S., MAX D. COUCH, B.S., and ALLEN SELHIME, B.S.

THAT INSECTS can develop resistance to insecticides has been known for approximately 50 years. However, the subject has been studied extensively in this country only during the last 6 years, following the development of resistance to DDT by houseflies. The literature on the development of insect resistance to insecticides has been reviewed by Babers (*1*) and Babers and Pratt (*2*). Several important references are given in the Yearbook of Agriculture for 1952.

The laboratory of the Entomology Research Branch of the United States Department of Agriculture conducted research at Orlando, Fla., from June 1951 to August 1954 on the resistance of the human body louse, *Pediculus humanus humanus* L., to DDT, lindane, Lauseto neu (chloromethyl *p*-chlorophenyl sulfone), pyrethrins, and pyrethrins plus sulfoxide (*n*-octyl sulfoxide of isosafrole).

Lindane, Lauseto neu, and pyrethrins were selected for study because of their general effectiveness against both normal and DDT-resistant lice. Lindane is of special interest because it has been adopted by the Armed Forces for the control of body lice in areas where resistance to DDT has developed.

The experimental development of resistance has usually been accomplished under laboratory conditions by selection. A concentration of toxicant that will cause moderate to high mortality is used, and the survivors serve as parents of the next generation. In some of the Orlando studies reported here the lice were exposed to very light deposits of insecticides which caused no apparent mortality or injury. The dosages varied with the insecticides, but most of them were approximately one-tenth those usually required to give a low mortality or moribundity.

The authors are entomologists with the Entomology Research Branch of the United States Department of Agriculture. Mr. Eddy is entomologist in charge of the Corvallis, Oreg., laboratory of the Insects Affecting Man and Animals Section. Mr. Cole and Mr. Couch, with the same section, are stationed at Orlando, Fla., and Mr. Selhime is with the Fruit Insects Laboratory at Orlando.

Previous Reports on DDT Resistance

A number of workers in the field and in the laboratory have reported on the development of DDT-resistant lice. Bushland and associates in 1945 (*3*) and Eddy and Bushland in 1948 (*4*) demonstrated that cloth impregnated

with a 0.05-percent DDT solution or treated with a powder containing 0.1 percent of DDT caused complete or nearly complete mortality of body lice in 24 hours. In 1950, King (*5*) reported that lice surviving single exposures to DDT at a concentration causing high mortality showed no resistance after several generations.

However, Hurlbut and associates in 1952 (*6*) failed to control lice on Korean military personnel with a powder containing 10 percent DDT and indicated that the failures were due to resistance. In the same year Barnett and Knoblock (*7*) showed that body lice in Japan were also resistant to DDT. Data on the susceptibility of the lice in Korea and Japan prior to the general use of DDT in those areas apparently were never obtained.

In 1953, Busvine (*8*) reported that a strain of lice from Egypt were resistant to DDT but susceptible to other insecticides. Hurlbut and associates (*9*) reported in 1954 that, after being in general use in Egypt since 1947, 10-percent DDT powder did not control lice any longer, and laboratory tests confirmed some degree of resistance to DDT.

Yasutomi (*10*) presented laboratory data in 1952 showing that body lice in Japan could develop considerable resistance to DDT in three generations and to BHC in two generations. The lice used by Yasutomi were obtained from vagrants in Ueno in Tokyo, Japan, and he assumed that they had had no previous exposure to either DDT or BHC. However, both chemicals had been available and rather widely used in Japan for several years.

The resistance of body lice in Korea to DDT and several other compounds was studied by Eddy in 1952 (*11*). He showed the lice in Korea to be at least 100 times more resistant to DDT than a laboratory strain of body lice maintained at Orlando, Fla. However, the resistance of the lice to certain other insecticides tested at the same time was not marked.

The resistant Korean lice were collected from prisoners of war who had been dusted with DDT from time to time during 6 to 9 months. In the tests made in Korea 10-percent DDT powder caused 60 percent mortality during a 24-hour exposure, which indicated that many insects in the population were susceptible.

Methods of Current Studies

For the current Orlando studies, two lots of lice highly resistant to DDT were obtained from Korea. The standard, or regular, colony was descended from lice collected in the United States before the advent of DDT.

The methods used for rearing the lice were essentially the same as those described by Culpepper (*12, 13*). The procedures described by Bushland and associates (*14*) and Eddy (*11*) were used to test the insecticides as cloth impregnants and as powders.

After rearing the resistant Korean lice for three generations without exposure to insecticides, a portion of one lot was maintained on cloth that had been impregnated with DDT by dipping it into a 0.01-percent solution in acetone. The remainders of the two lots were then combined and maintained on untreated cloth.

At first all Korean lice were fed twice daily on human subjects, but later they were fed on rabbits once each day. The standard colony had been fed on rabbits for a number of years.

Resistance to DDT

In the tests with the Korean lice maintained on cloth impregnated with 0.01 percent DDT, application of 10 percent DDT caused high but incomplete mortality during the first few generations. However, the resistance gradually increased, and by the 15th generation few or none of the lice were killed in 24 hours.

In another experiment 100 young adult body lice (50 of each sex) from the regular colony, which had had no previous contact with DDT, were placed on cloth impregnated with DDT by dipping it into a 0.001-percent solution. The lice were transferred to freshly impregnated cloth three times weekly. The resistance developed is shown in the table. Most of the data represent averages of 2 tests with 20 lice (10 of each sex) per test and an exposure period of 24 hours. The lice maintained on DDT showed slight resistance by the 5th generation and by the 8th generation were approximately five times as resistant as those of the regular colony. By the 16th generation resistance was very high, but could not be measured accurately as the highest test concentration of DDT (10 percent)

failed to kill all the lice. There was a slight additional increase in resistance by the 25th generation, after which this colony was discontinued.

How much selection, or mortality of susceptible individuals, occurred during the first few generations and whether selection was primarily responsible for the degree of resistance developed were not determined. In subsequent tests to check on these points it was found that adult lice maintained on cloth treated with 0.001 percent DDT did not live quite as long as the controls or lay quite as many eggs. However, the difference did not appear to be sufficient to justify the conclusion that resistance was developed through selection alone.

Other tests indicated that nonresistant lice could be maintained on cloth treated with 0.0001 percent DDT with no more mortality than those maintained on untreated cloth. Accordingly, 2 colonies each with 200 newly hatched nymphs were established on this concentration of DDT and two on untreated cloth. Mortality through seven generations was less for lice exposed to DDT than for the controls. This study is being continued.

Loss of DDT Resistance

A portion of the resistant colony obtained from Korea was reared on untreated cloth to determine the number of generations required for the lice to lose their resistance. Loss of resistance was evident by the third generation and complete by the eighth.

After 17 generations had been maintained on cloth treated with 0.01 percent DDT, another portion of the resistant Korean colony was removed from DDT and reared on untreated cloth. The colony showed practically no loss of resistance after six generations but a considerable loss by the ninth generation. After 9 generations concentrations of 0.1, 1, and 10 percent of DDT caused 45, 75, and 75 percent knockdown and kill, respectively. Little or no further loss was indicated in tests of the 25th generation. Eventually the lice will probably lose their resistance, but apparently many generations will be required.

Lindane and Lauseto neu

Development of resistance to lindane and Lauseto neu was attempted by the method described above for DDT, that is, by continuously exposing the lice to sublethal concentrations of the insecticides. The concentrations used were 0.00005 percent for lindane and 0.0025 percent for Lauseto neu. The body lice used in these studies were from the Korean colony that had lost its resistance to DDT. In view of this, resistance to both insecticides, especially lindane, was expected to develop.

Lice of the fifth generation exposed to lindane and Lauseto neu showed no more than twice as much resistance as the regular colony. The

Relative susceptibility to DDT of normal body lice and lice maintained on cloth impregnated with 0.001-percent DDT solution for various numbers of generations

Percent concentration	Percent knockdown and mortality after indicated number of generations									
	5		8		12		16		25	
	DDT	Normal	DDT	Normal	DDT	Normal	DDT	Normal	DDT	Normal
10.0	------	------	------	------	90	------	95	------	90	------
5.0	------	------	------	------	100	------	88	------	85	------
1.0	------	------	------	------	100	------	90	------	70	------
0.1	100	100	------	------	90	------	75	------	55	------
0.05	------	------	100	------	95	------	65	100	75	------
0.025	98	98	80	100	65	100	48	98	45	100
0.01	78	98	60	100	70	95	18	95	15	95
0.005	73	98	50	85	35	55	13	83	5	80
0.0025	45	93	40	45	0	45	0	65	0	10
0.001	10	43	10	5	0	5	3	5	0	0
Control (untreated)	------	13	------	0	------	0	------	0	------	0

lice have now been reared through 34 generations without any further increase in resistance to either material. The amount of resistance developed thus far is so slight that it seems well within the variation expected with any insecticide.

Pyrethrins and Pyrethrins Plus Sulfoxide

The lice used in studies with pyrethrins were taken from the regular colony, which had had no previous contact with DDT or other insecticides. As in the tests with the other materials, the lice were maintained on cloth treated with sublethal concentrations—0.001 percent of pyrethrins alone and 0.0001 percent of pyrethrins plus 0.001 percent of sulfoxide. No more than twofold resistance to pyrethrins was indicated in tests against different generations of lice up to and including the 17th, at which time the colony was discontinued. The pyrethrum-sulfoxide colony appeared to be no more resistant than the regular colony after 30 generations. Studies with this colony are being continued.

Summary

Studies were conducted on the development and loss of resistance of the body louse (*Pediculus humanus humanus* L.) to DDT, lindane, Lauseto neu (chloromethyl *p*-chlorophenyl sulfone), pyrethrins, and pyrethrins plus sulfoxide. The more important findings are:

1. Highly but not completely DDT-resistant body lice from Korea lost their resistance in 3 to 8 generations when maintained in a DDT-free environment.

2. DDT-resistant lice from Korea developed extreme resistance in 15 generations when maintained on cloth impregnated with a 0.01-percent DDT solution.

3. Extremely resistant lice lost approximately 75 percent of their resistance in 15 generations after being removed from contact with DDT.

4. Body lice from the regular colony, which had never been exposed to DDT, developed a high resistance in 25 generations when maintained on cloth impregnated with 0.001 percent of DDT. There was a very low mortality in the initial exposures, but resistance developed.

5. Body lice maintained for 34 generations on cloth impregnated with low concentrations of lindane and Lauseto neu and 17 generations on pyrethrins failed to develop more than twofold resistance to these insecticides. Lice maintained on pyrethrins plus sulfoxide failed to develop any resistance in 30 generations.

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Sanitary Engineering Degrees Given in 1954

By ARTHUR P. MILLER, C.E.

IN 1954 in the United States, there were 164 graduates from undergraduate sanitary engineering courses. Graduate degrees granted consisted of 120 master's and 9 doctor's.

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The institutions awarding the degrees are shown in the table. Similar data for undergraduates during the periods 1889–1950, 1951–52, and 1953, and for those awarded master's and doctor's degrees during the 54-year period 1899–1953 have been presented in earlier reports by the author (see list).

Undergraduate Degrees

All but 8 of the 40 colleges and universities reporting the availability of undergraduate courses in sanitary engineering had one or more graduates in 1954. There were 216 graduates in 1953 and an average of 242 per year for the 5-year period 1949–53. The number of graduates per 1,000 engineering graduates was 7.5 in 1954; 9.0 in 1953; and 6.2 in the 5-year period 1949–53.

Number of degrees in sanitary engineering, by level, granted in the United States, 1954

Institution [1]	Doctor's	Master's	Bachelor's
Alabama Polytechnic Institute	----	0	0
Alabama, University of	----	0	2
Arkansas, University of	----	1	----
California, University of	0	9	11
Case Institute of Technology	----	1	----
Colorado, University of	----	0	4
Cornell University	0	0	3
Florida, University of	----	2	3
Georgia Institute of Technology	----	1	2
Harvard University	2	20	----
Illinois, University of	1	5	4
Iowa, State University of	0	3	4
Johns Hopkins University	1	8	----
Kansas, University of	----	0	5
Louisiana State University	----	----	0
Maine, University of	----	0	1
Manhattan College	----	----	17
Massachusetts Institute of Technology	3	9	5
Michigan College of Mining and Technology	----	0	11
Michigan State College	0	2	2
Michigan, University of	0	10	2
Minnesota, University of	0	3	0
Mississippi State College	0	0	22
Missouri School of Mines and Metallurgy	0	0	5
Missouri, University of	0	3	2
New York University	0	4	5
Newark College of Engineering	0	3	6
North Carolina State College	0	1	0
North Carolina, University of	0	9	10
Ohio State University	0	1	3
Oklahoma Agricultural and Mechanical College	0	0	3
Oklahoma, University of	----	1	0
Oregon State College	0	1	4
Pennsylvania State University	0	3	7
Purdue University	0	3	0
Rensselaer Polytechnic Institute	----	0	4
Rutgers University	----	0	1
Santa Clara University	----	----	0
Southern California, University of	----	3	----
Texas, Agricultural and Mechanical College of	0	0	7
Texas, University of	0	2	2
Tulane University of Louisiana	----	0	0
Utah State Agricultural College	----	----	1
Utah, University of	0	1	----
Virginia Polytechnic Institute	0	5	12
Washington, State College of	----	2	----
Washington, University of	0	3	----
Wayne University	----	0	0
West Virginia University	----	0	1
Wisconsin, University of	2	1	3
Total	9	120	164

Leaders (----) indicate no courses offered at this level.

[1] Other institutions offering sanitary engineering courses at the master's (*m*) or doctor's (*d*) level are: California Institute of Technology (*d*); Connecticut, University of (*m*); Idaho, University of (*m*); Illinois Institute of Technology (*m, d*); Iowa State College (*m, d*); Kentucky, University of (*m*); North Dakota, University of (*m*); Northwestern Technological Institute (*m, d*); South Dakota State College (*m*); Tennessee, University of (*m*); and Wyoming, University of (*m*).

Master's Degrees

Of the 120 master's degrees granted in 1954, 25 were awarded to nationals of foreign countries. Thirty, or 54 percent, of the 56 institutions offering graduate work in sanitary engineering at the master's level had graduates. Eight universities conferred 75 of the 120 degrees and 22 other universities awarded the remaining 45 degrees.

The number of master's degrees granted in 1953 was 102, of which 20 were earned by foreign nationals. The average number of master's degrees granted for the 5-year period 1949–53 and the 10-year period 1944–53 were 129 and 108, respectively.

Doctor's Degrees

The 9 doctor's degrees awarded in 1954 by 5 institutions were all to nationals of the United States. In 1953, 5 doctor's degrees, 3 of which were to foreign nationals, were granted. In the 5-year period, 1949–53, the average number of degrees conferred per year was 6; in the 10-year period, 1944–53, it was 4.

Twenty-one universities offering work at the doctor's level had no successful candidates in 1954 (see footnote to the table).

PREVIOUS REPORTS

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PHS Staff Announcements

Dr. Kenneth W. Chapman, a specialist in narcotic addiction programs, has been assigned to the Community Services Branch of the National Institute of Mental Health. Dr. Chapman will provide consultative services to State and community governmental agencies and voluntary organizations on the prevention, treatment, and control of drug addiction. He has been executive secretary of the Public Health Service Committee on Drug Addiction.

Graduated from Yale Medical School in 1938, Dr. Chapman entered the Service the following year. Since 1946, he has worked on medical problems of drug addiction, principally at the Public Health Service Hospital in Lexington, Ky., where he was medical officer in charge from 1952–54. In 1955 he became head of the Neuropsychiatry Branch of the Division of Hospitals of the Bureau of Medical Services, Public Health Service.

Dr. John W. Knutson, chief dental officer and Assistant Surgeon General of the Public Health Service, has been assigned to the World Health Organization for 6 months in order to organize a dental program. Dr. Knutson took over his duties in Geneva on July 1, 1955. Last year he was chairman of an international group of dental consultants convened in Geneva by the World Health Organization, and currently he is vice president of the Public Dental Health Services Commission of the Federation Dentaire Internationale. Dr. Knutson was a founding member of the American Board of Dental Public Health.

Pennsylvania's Aid To Cities in Financing Sewage Treatment Plants

By Charles H. Young

PENNSYLVANIA, under 1953 legislation, is helping municipalities defray the cost of operating sewage treatment plants required by the State for the control of water pollution.

Earlier legislation, enacted in 1937, and known as the clean streams law, required construction of the plants. Both the construction and operation costs were to be borne by the municipalities.

The new act, No. 339, marks a change of thinking on the part of the Pennsylvania Legislature since it begins a program of annual subsidies to be paid to municipalities to assist in meeting the costs of the sewage treatment works.

The intent of the Pennsylvania General Assembly was set forth in the preamble of the 1953 act. The preamble is quoted in part and the main provisions are summarized on the following page.

Rules and Regulations

The Pennsylvania Department of Health prepared rules and regulations for the administration of the act. It also prepared application forms for the use of municipalities and municipality authorities in filing construction costs. The rules and regulations are intended primarily to clarify the eligibility of projects, or parts of projects, or items entering into the cost of construction. They stipulate what is required in a general drawing to accompany the applications to show clearly the project for which payment is requested. They explain proportioning costs of projects or parts of projects when the total project involves more than is eligible for payment consideration. Under the regulations the costs of acquisition or construction are exclusive of grants or equivalent funds received from the State or Federal Government. The regulations further provide for payments to be made to other than the applicant, since many of the municipal authority projects are operated by the municipality under a lease-back agreement. The regulations also require the documentation of costs and provide for other features.

Allowed in determining the cost of acquisition or construction, or both, of the sewage treatment works, intercepting sewer, and pump station are: cost of the plant or pump station site, or both, and rights of way; engineering costs of the report, plans, specifications, supervision and inspection of construction; contract cost for the allowable treatment facilities and appurtenances, including supplemental contracts; financial costs; legal costs, and interest during construction. All cost data must be documented, and breakdowns of the construction costs and other costs are required where such breakdowns are necessary to establish clearly the cost eligibility of the project.

Experience to Date

A few of the municipalities have experienced difficulties in documenting the costs of their projects, particularly projects constructed in the years shortly after the effective date, September 1, 1937, of the clean streams law. These difficulties, however, have been reduced to date to several cases which are being handled on an individual basis.

A total of 124 applications were filed. For various reasons, the number has been reduced to 103. To date, 92 applications have been processed and the municipalities or municipality authorities have been paid a total of $798,920.28. These municipalities received 2 percent of the approved costs. The remaining applications are in process.

Even though this legislation was given considerable publicity and form letters were mailed to all municipalities that were believed entitled to payment, a few Pennsylvania municipalities did not take advantage of this legis-

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Preamble of Pennsylvania's Act No. 339

"Whereas, The Commonwealth of Pennsylvania under the Act of Assembly approved the twenty-second day of June, one thousand nine hundred thirty-seven (Pamphlet Laws 1987), has required certain municipalities of this Commonwealth to construct sewage treatment plants to abate the pollution of the waters of the Commonwealth and thereby preserve and improve the purity of such waters in the interest of the public health; and,

"Whereas, these municipalities have in the past and will in the future expend large sums of money to acquire and construct sewage treatment plants in accordance with the Clean Streams Program and the aforesaid Act of Assembly, which sewage treatment facilities benefit not only the local municipality but are a benefit to all of the citizens of the Commonwealth of Pennsylvania; and,

"Whereas, the responsibility to preserve and improve the purity of the waters of the Commonwealth does not rest solely upon municipal government but is also a function and responsibility of State government acting in the interest of the general public health, the Commonwealth of Pennsylvania, in consideration of the benefits resulting from the acquisition and construction, both in the past and in the future, of sewage treatment plants by municipalities . . ."

Main Provisions

1. Commencing July 1, 1954, and annually thereafter, the Commonwealth shall pay toward the cost of operating, maintaining, repairing, replacing, and other expenses relating to sewage treatment plants, an amount not to exceed 2 percent of the costs for the acquisition and construction. The annual payments are to be made to municipalities and municipality authorities which have acquired and constructed sewage treatment works since September 1, 1937. The payments are to be made for the year up to and including December 31 of the year preceding the year in which such payment is made, and as is ascertained by the secretary of health and approved by the Governor.

2. The word "construction" shall include, in addition to the construction of new treatment works, pumping stations, and intercepting sewers, which are integral parts of the treatment facilities, the altering, improving, or adding to of existing treatment works, pumping stations, and intercepting sewers which are essential to the sewage treatment plant system.

3. The Pennsylvania Department of Health is authorized to promulgate rules and regulations for the administration of the act.

4. The amounts to be paid for the foregoing purposes shall be based upon reports filed with the secretary of health prior to January 31, 1954, and annually thereafter.

5. The sum of $2 million was appropriated to initiate payments to the municipalities and municipality authorities.

lation by filing applications for payment in 1954.

The reaction to this legislation has been generally favorable. It has been particularly favorable from municipalities which have constructed plants in recent years under high costs and from those municipalities which are preparing to construct plants.

The payments to municipalities to date have ranged from a minimum of $116.07 to a maximum of $209,591.72. The latter represents a partial payment; the full payment will amount to approximately $250,000. The 2-percent annual payment is estimated to represent approximately 15 to 30 percent of the total annual operating expenses, including debt service, depending on the nature of the project. The payments may be used to reduce annual operating costs of the works, thereby reducing the annual sewer rental costs, or to accelerate debt retirement, or a combination of these. It will be interesting to see whether subsequent legislatures will make appropriations to continue the subsidy payments.

technical publications

Cardiovascular Disease

Data on mortality, prevalence, and control activities

Public Health Service Publication No. 429. 1955. 68 pages.

Designed particularly for use by workers in the heart disease field, this booklet provides information on the mortality and prevalence of cardiovascular-renal disease and on heart disease control activities.

In general, the data permit comparisons among various population groups, among States, or among geographic regions. Also shown are results of case finding among various population groups and for various screening techniques.

Manual of Serologic Tests for Syphilis

Public Health Service Publication No. 411, revised 1955. 106 pages; illustrated. $1.00.

The latest technical procedures to be observed in the performance of each of the reliable, evaluated serologic tests for syphilis now commonly employed in the United States have been assembled in this manual by the Venereal Disease Research Laboratory in collaboration with the test author-serologists.

Included are the APHA, Hinton, Kahn, Kline, Kolmer, Mazzini, Rein-Bossak, and VDRL tests as well as chapters on general information and general equipment. The appendix describes methods of collection and preservation of sheep blood, preparation of hemolysin, preparation and preservation of complement, use of merthiolate as a bacteriostat, and quantitative determination of spinal fluid protein.

Especially designed for use in laboratories, the manual has a plastic-coated cover and plastic comb binding. It is the fifth edition of the Manual of Serologic Tests for Syphilis published by the Venereal Disease Program, previously issued as supplements 9, 11, and 22 to the Journal of Venereal Disease Information and VD-Graphic 85.

A Comprehensive Program for Water Pollution Control

Central Columbia River Basin. Public Health Service Publication No. 381. Water Pollution Series No. 69. 1954. 20 pages; illustrated.

Adopted by the Public Health Service from a program developed by the Washington Pollution Control Commission in cooperation with the State Department of Public Health, this program is based on beneficial water uses and related conditions that prevailed on January 1, 1954.

Green Bay Western Shore Drainage Basin. Public Health Service Publication No. 368. Water Pollution Series No. 67. 1955. 42 pages; illustrated.

Developed in cooperation with the State Water Pollution Control Agencies of Michigan and Wisconsin and Federal agencies and adopted by the Public Health Service, this program is based on data available as of January 1, 1954.

Lake Superior Drainage Basin. Public Health Service Publication No. 367. Water Pollution Series No. 66. 1954. 51 pages.

Program prepared in cooperation with the Michigan, Minnesota, and Wisconsin water pollution control agencies on data available as of January 1, 1954.

Mississippi-Iowa-Cedar Rivers Basin. Public Health Service Publication No. 346. Water Pollution Series No. 61. 1955. 41 pages.

Adopted by the Public Health Service from a program developed by the Illinois, Iowa, and Minnesota State water pollution control agencies, based on beneficial water uses and related conditions that prevailed on July 1, 1953.

Mississippi-Salt Rivers Basin. Public Health Service Publication No. 366. Water Pollution Series No. 65. 1954. 24 pages; illustrated.

Adopted by the Public Health Service from a program developed by the Illinois, Iowa, and Missouri State water pollution control agencies, based on beneficial water uses and related conditions that prevailed on January 1, 1954.

Mississippi-Wapsipinicon and Tributaries Rivers Basin. Public Health Service Publication No. 347. Water Pollution Series No. 62. 1954. 47 pages; illustrated.

Adopted by the Public Health Service from a program developed by the Illinois, Iowa, Minnesota, and Wisconsin State water pollution control agencies, based on the beneficial water uses and related conditions that prevailed on July 1, 1953.

Salaries of Local Public Health Workers, August 1954

Public Health Service Publication No. 425. 1955. 41 pages.

This report contains data from the 5th study of salaries of selected classifications of public health workers in official agencies and from the 15th study of public health nurses employed by local nonofficial health agencies and local boards of education.

Presented are salary data by $200-intervals, according to population group served and by regions of the Department of Health, Education, and Welfare, for each of the following occupations:

Local health officers (medical), public health physicians (exclusive of health officers), sanitary engineers, sanitarians (including other sanitation personnel), veterinarians, professional laboratory workers, health educators, and public health nurses (supervising, staff, and clinic).

technical publications

Meeting the Challenge of Cancer

Public Health Service Publication No. 419. 1955. 23 pages. 15 cents.

This booklet supplements The Challenge of Cancer, a 116-page book by Lester Grant, published in 1950 under the joint sponsorship of the National Cancer Institute of the Public Health Service and the National Cancer Institute of Canada. It presents some of the accomplishments in cancer research since that time.

In the supplement, prepared by the National Cancer Institute, the first section delineates the sources of financial support for cancer research and the programs of leading organizations. It also discusses the postwar shift in emphasis from basic to clinical research. The next two sections deal with advances in diagnostic and therapeutic technique and with promising areas of research in these fields. The chemotherapy of cancer is given special attention in a separate section; a review of recent studies in the epidemiology of cancer and a list of source materials complete the supplement.

Grant and Award Programs of the National Institutes of Health

Public Health Service Publication No. 415. 1955. 22 pages.

Scientists, public health workers, students, and others interested will find in this publication comprehensive information about the grant and award programs authorized by the Public Health Service Act and administered by the National Institutes of Health, Public Health Service. Details are given for the types, scope, and purposes of the grants and awards; availability of funds; eligibility requirements for recipients; location of training; and opportunities afforded trainees.

The grants and awards are offered to encourage and support research, investigation, and training in health, medical, dental, and allied fields for which other funds have not been provided or which might not otherwise be conducted.

Evaluation in Mental Health

A review of the problem of evaluating mental health activities

Public Health Service Publication No. 413. 1955. 292 pages. $2.00.

Problems and processes of evaluative studies are reported from a survey made by a subcommittee of the National Advisory Mental Health Council. The survey, begun in 1951, was designed to assist professional workers in improving the scientific basis for mental health programs and in evaluating the effects of their practical operations.

The report of this survey assembles an annotated bibliography of the evaluative studies and presents observations and suggestions arising from collection and analysis of the materials.

Reported Tuberculosis Morbidity and Other Data Calendar Year 1953

Public Health Service Publication No. 442. 1954. 27 pages. 25 cents.

This second published summary of the data supplied to the Public Health Service on the annual tuberculosis report form PHS–1393 tabulates newly reported tuberculosis cases by source of morbidity report, activity status, form and extent of the disease, race, sex, and age. Data on X-ray case-finding activities, mortality, and public health nursing visits are also included.

The data, received from all the States, the District of Columbia, Alaska, Hawaii, and Puerto Rico, are intended primarily for reference use. Summaries giving limitations and uses of the data are prepared for each analytical table.

Meeting Community Health Needs

Public Health Service Publication No. 403. (Revision of You'll Want to Know About Your Hospital Program, PHS Pub. No. 8, May 1951.) Revised 1954. 1-fold leaflet.

Operation of the Hospital and Medical Facilities Survey and Construction (Hill-Burton) Act is explained in this leaflet. It tells what community facilities are eligible to receive Federal assistance under the law as amended in 1954. And it explains the application requirements and procedures for obtaining Federal assistance in building a hospital or related health facility. The agency administering the hospital and medical facilities survey and construction program in each State is listed.

This section carries announcements of all new Public Health Service publications and of selected new publications on health topics prepared by other Federal Government agencies.

Publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Public Health Service, Washington 25, D. C.

The Public Health Service does not supply publications issued by other agencies.

U. S. GOVERNMENT PRINTING OFFICE: 1955